

NATURAL RESOURCES AND ENVIRONMENTAL AFFAIRS
Marine Corps Base
Camp Lejeune, North Carolina 28542

4-29-86

Date

From: Director

To:

Danny

Subj:

For info

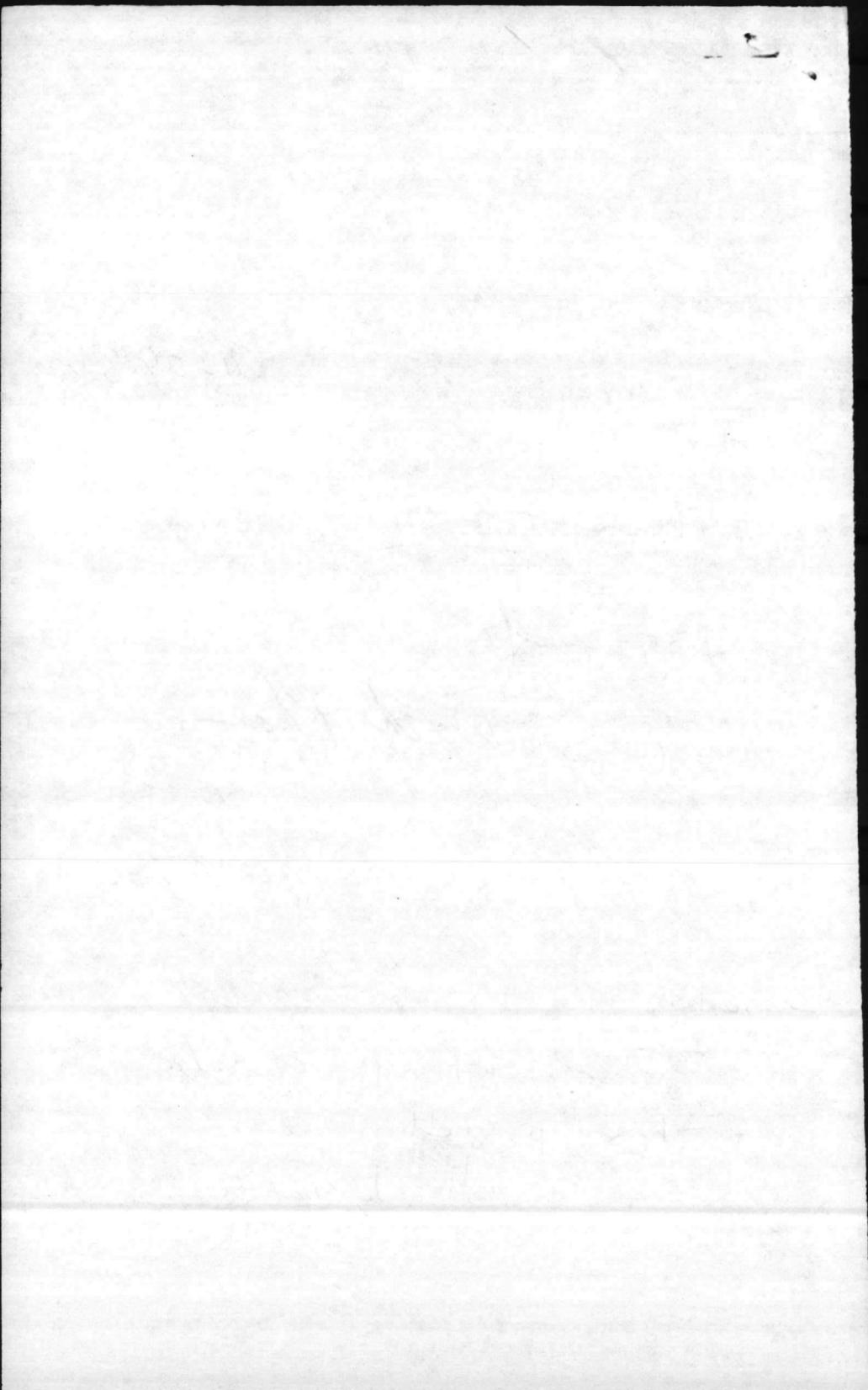
USGS Work Plan

Julian

Betsy:

*Please set up a file
on this project.*

D. Lange



WORK PLAN FOR PHASE 1
(April 1, 1986 - April 1, 1987)

Work items to be accomplished during Phase 1 will be based almost entirely on existing data.

WORK TASK I Compile all available ground-water data from USGS, State, and Camp Lejeune files for the area, including water-level, water-quality, water-use, and well log data. Construct a computer data set of this data that will facilitate future statistical analysis.

- a. Compile USGS data sources.
- b. Compile N.C. Department of Natural Resources and Community Development data sources.
- c. Compile Camp Lejeune data resources.
- d. Inventory existing wells, take water-quality samples, and evaluate field parameters including chloride concentration, bromide concentration, pH, temperature, dissolved oxygen, specific conductance.

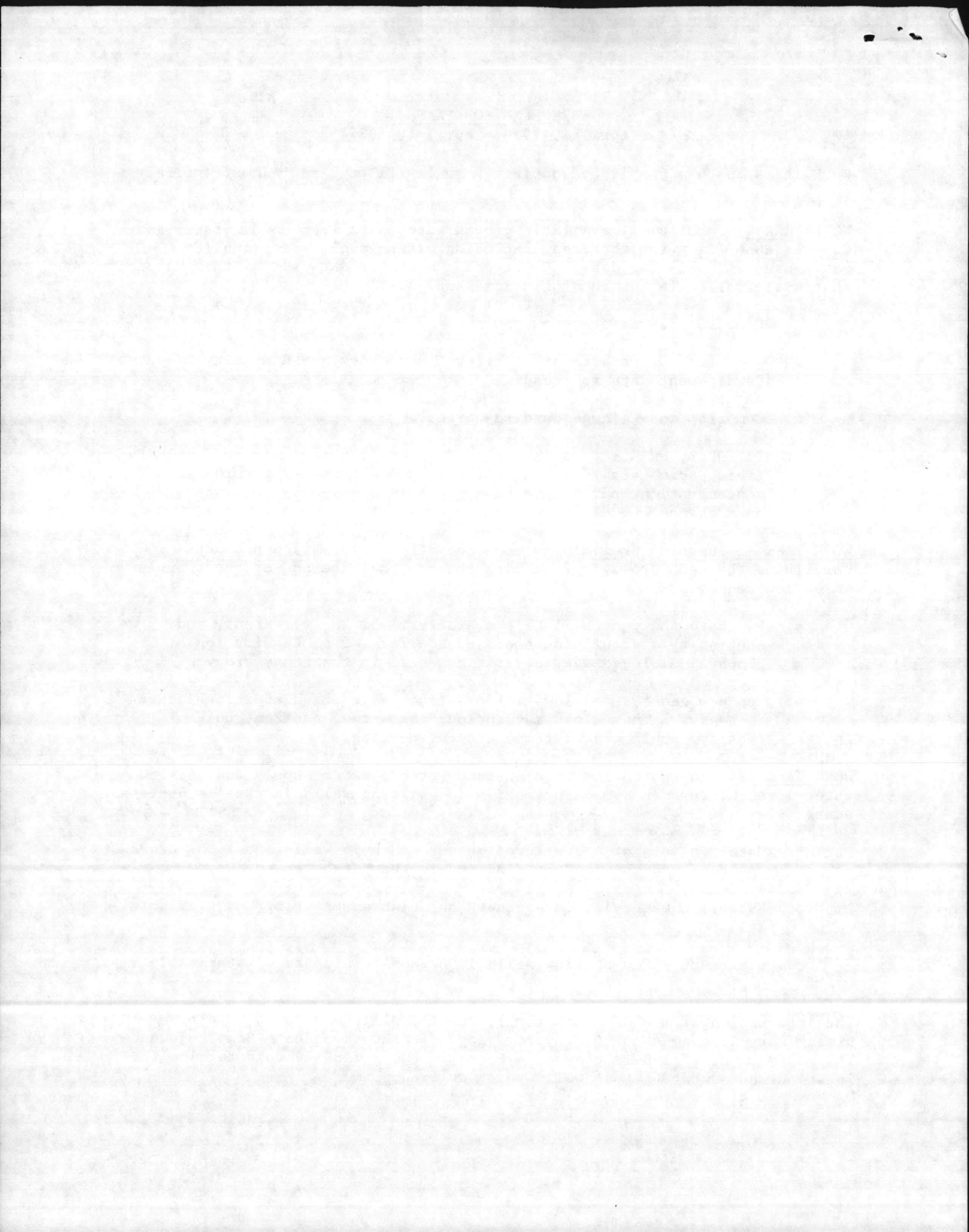
WORK TASK II Develop preliminary maps and other information products describing the geohydrologic framework beneath the base and adjacent areas in Onslow County.

- a. Evaluate the general lithic character, thickness, extent, and continuity of confining beds and aquifers, from examination of geophysical logs made in existing wells in the study area.
- b. Run new geophysical logs for existing wells where additional data is needed. These logs may include gamma-ray, neutron, bulk density, sonic gravel-time, and caliper logs.

WORK TASK III Map potentiometric surfaces of the water-supply aquifer from water-level measurements made primarily in existing wells in the ~~Air Station~~ *Camp Lejeune* area.

- a. Make two sets of water-level measurements in wells and local creeks and streams, one in "wet" and one in the "dry" season.
- b. Establish water-level recorders on selected existing and available wells.
- c. Construct a few shallow wells if needed to prepare a water-table map.

The information from WORK TASKS I, II, and III will be used to make a preliminary assessment of the hydrogeologic framework beneath Camp Lejeune. This assessment will be reviewed in Phase 2a (WORK TASK I) to determine the location and number of test wells to be drilled.



WORK TASK IV Prepare report on the results of the Phase 1 investigations with appropriate illustrations and data tables. The proposed title of the Phase 1 report is "A preliminary geohydrologic framework of the Camp Lejeune Marine Corps Base area, N.C."

WORK PLAN FOR PHASE 2

(Years 2 and 3 (April 1, 1987 - March 30, 1989))

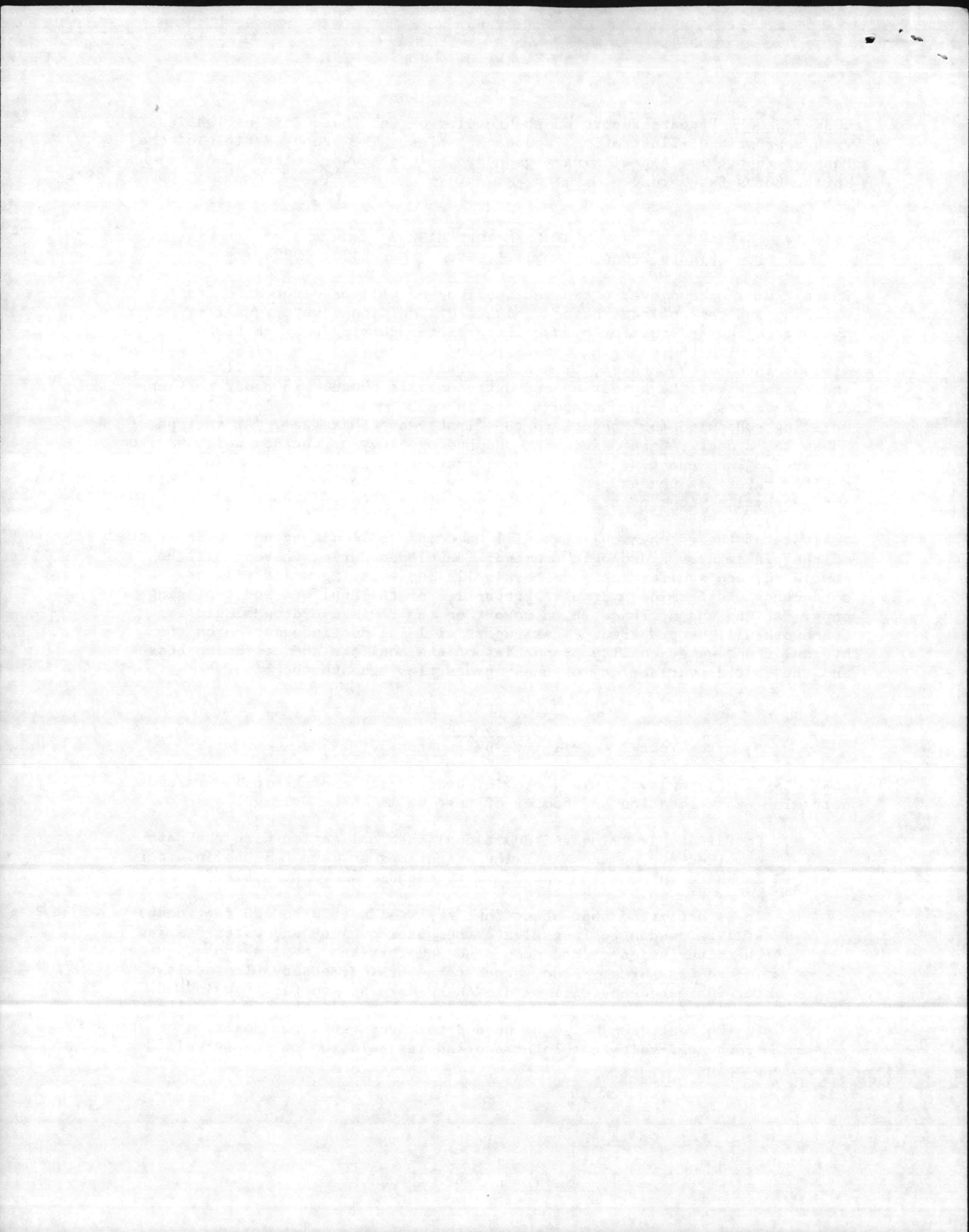
Phase 2 will extend over a two-year period and will be devoted to test drilling and the collection and analysis of additional water quality, hydrogeologic, and aquifer hydraulic-parameter data. The work tasks associated with the drilling, testing, and analysis of new well data will be divided into two subphases, 2a and 2b. Phase 2a will be a drilling phase and Phase 2b will be a testing and data-analysis phase. In order to keep drilling costs at a minimum, an effort is to be made to complete all test drilling scheduled for Phase 2 in the first year (Phase 2a). At the end of Phase 2a, a data report describing the hydrogeology of the new wells will be prepared. The report will include information on geologic formations and aquifer materials penetrated by the test wells, water quality in the wells, and geophysical logs completed by the end of 2a. During the third year of the study, or Phase 2b, geophysical logging of wells will be completed, analysis of the geophysical logs will be completed, editing and refinement of the preliminary hydrologic framework developed during Phase 1 will be completed, and aquifer tests on test wells and existing wells will be conducted to determine hydraulic properties of the aquifers and confining beds. At the end of Phase 2b, a report on the revised hydrogeologic framework will be prepared. This report will include information on the hydraulic and water-quality properties of the aquifers and confining beds and the spatial variability of these properties beneath the base.

PHASE 2a

Year 2 (April 1, 1987 - March 30, 1988)

WORK TASK I Review available geologic, hydrologic, and chemical data and determine exact location and number of test wells to be drilled.

- a. Coordinate drilling and additional data collection with the data compiled during the NACIP investigations at Camp Lejeune in order to share information and minimize expense where possible.
- b. It is estimated that about four test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area. Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the freshwater-saltwater interface and its relation to supply-well pumping.



WORK TASK II Prepare drilling specifications, distribute specifications for bids, and award contract.

WORK TASK III Drill test wells and collect data needed to determine and verify the physical and chemical characteristics of the aquifer and confining-bed materials and fluids that overlie and occur within the deep, limestone water-supply aquifer.

- a. Collect split-spoon samples of aquifer and confining-bed materials at specified depth intervals and analyze selected samples to determine chemical and hydraulic characteristics.
- b. Collect ground-water samples from test wells at specified depths and analyze samples for selected constituents including concentrations of chloride, heavy metals, and organic compounds that can be associated with the work activities at Camp Lejeune.
- c. Make water-level measurements and selected hydraulic tests at specified depth intervals in the test wells to determine the distribution of hydraulic head and hydraulic conductivity.
- d. Make geophysical logs in test wells selecting combinations of gamma-ray, neutron, bulk density, sonic travel-time, resistivity, spontaneous potential, and conductivity surveys best suited to data needs.

WORK TASK IV Prepare report on the results of Phase 2a investigations with appropriate illustrations and data tables. This will be a data report that describes test- and observation-well construction and the new hydrogeologic data from the test wells. The proposed title of the Phase 2a report is "Well logs and hydrologic data from test wells at Camp Lejeune Marine Corps Base, North Carolina." The well logs will include both geophysical and lithologic logs.

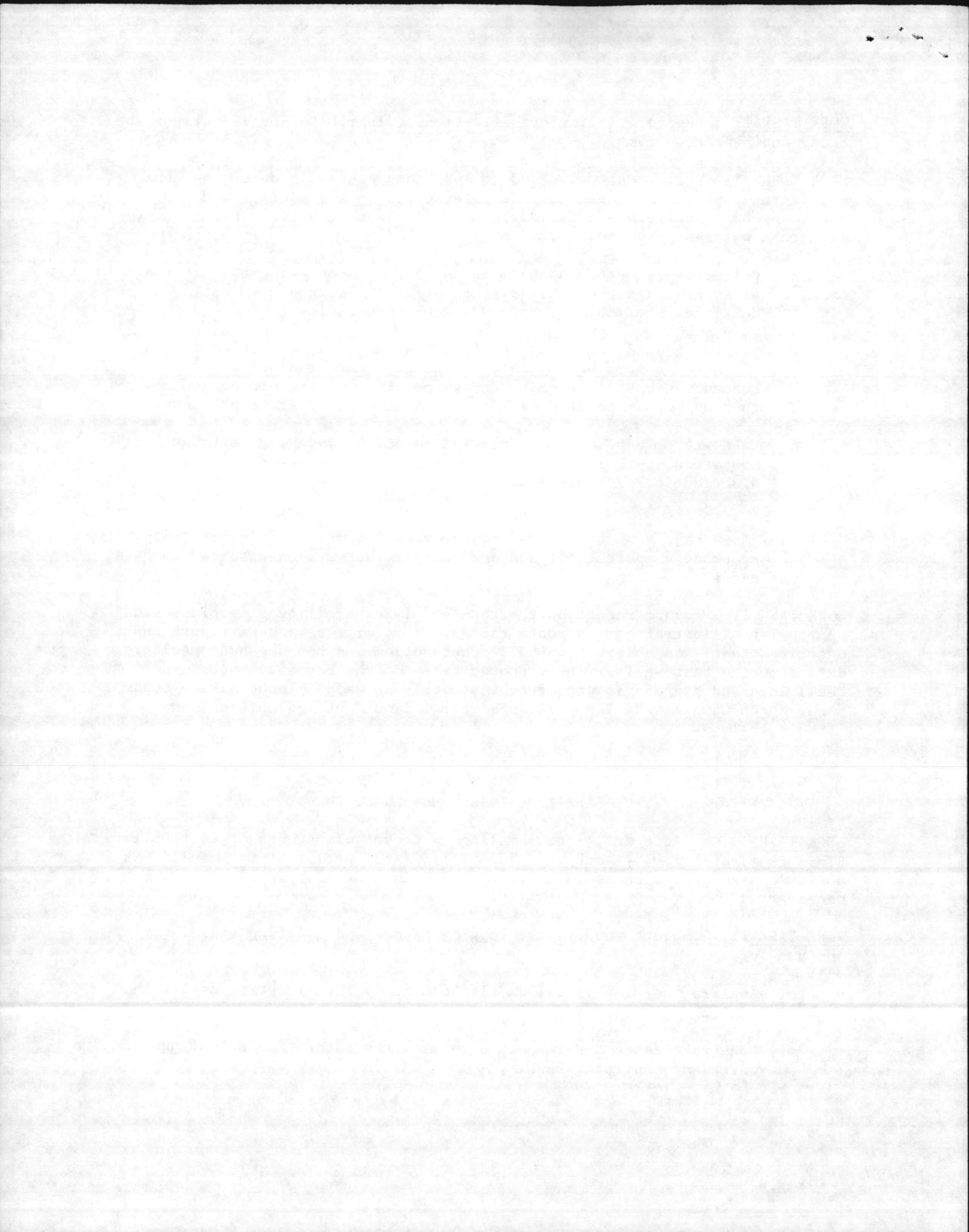
PHASE 2b

Year 3 (April 1, 1988 - March 30, 1989)

WORK TASK I Complete drilling, sampling, and hydraulic tests of test wells. (This is first priority work item if drilling and testing of test wells was not completed during Phase 2a or if the drilling of additional wells became necessary.)

WORK TASK II Complete geophysical logging of new and existing wells. Analyze logs.

- a. Analyze the geophysical and lithologic logs to identify depths to aquifer units and confining beds.
- b. Construct fence diagrams to determine the lateral extent of aquifer units and confining beds.



WORK TASK III Conduct aquifer tests on new and existing wells to determine hydraulic properties of aquifer unit(s) and confining beds.

WORK TASK IV Based on new findings, refine and edit the preliminary assessment of the hydrogeologic framework that was developed during Phase 1.

WORK TASK V Prepare a report that describes the refined hydrogeologic framework. The proposed title of the phase 2b report is "Hydrogeologic framework beneath Camp Lejeune Marine Corps Base, North Carolina."

WORK PLAN FOR PHASE 3

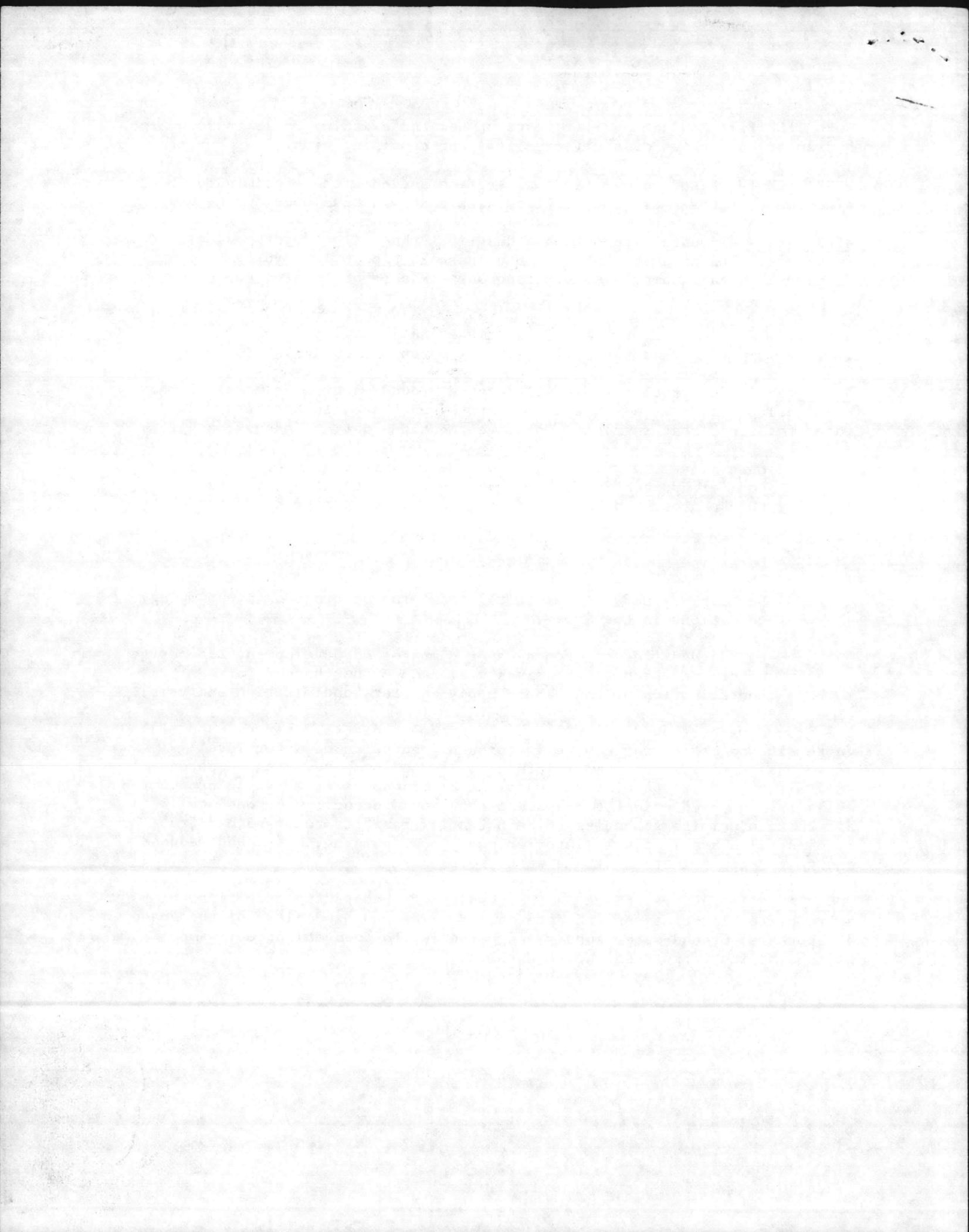
Year 4 (April 1, 1989 - March 30, 1990)

WORK TASK I Construct a finite-difference ground-water flow model of the hydrogeologic system in and around Camp Lejeune based on the data and interpretations that resulted from investigations during Phases 1 and 2.

- a. Determine grid system for area and discretize appropriate maps of aquifer and confining-bed characteristics (such as structure tops, thicknesses, hydraulic conductivity, potentiometric surfaces, etc.).
- b. Determine boundary conditions.
- c. Develop a steady-state digital model for unstressed (pre-pumping) conditions in the area.
- d. Evaluate different ground-water pumpage and development schemes to determine which alternatives will reduce the chances for contamination of the water-supply aquifer (optimization analysis).

The ground-water flow model will be a management aid that can be used (1) to guide site selection for new wells through prediction of water-level drawdowns that will occur in response to planned pumping rates at potential well sites, and (2) to evaluate water-level drawdowns at existing production wells through prediction of drawdowns that would occur in response to alternative pumping schedules. The potential benefits to be gained from model studies are less well interference, lower pumping costs, and reduced chance for contamination of the water supply.

WORK TASK II Prepare report on the results of Phase 3 investigations with appropriate illustrations and data tables. The proposed title of the Phase 3 report is "Ground-water supply and potential for contamination--Camp Lejeune Marine Corps Base, North Carolina."



NATURAL RESOURCES AND ENVIRONMENTAL AFFAIRS

Marine Corps Base

Camp Lejeune, North Carolina 28542

2 Aug 89

Date

From: Director

To: *DP*
Dan

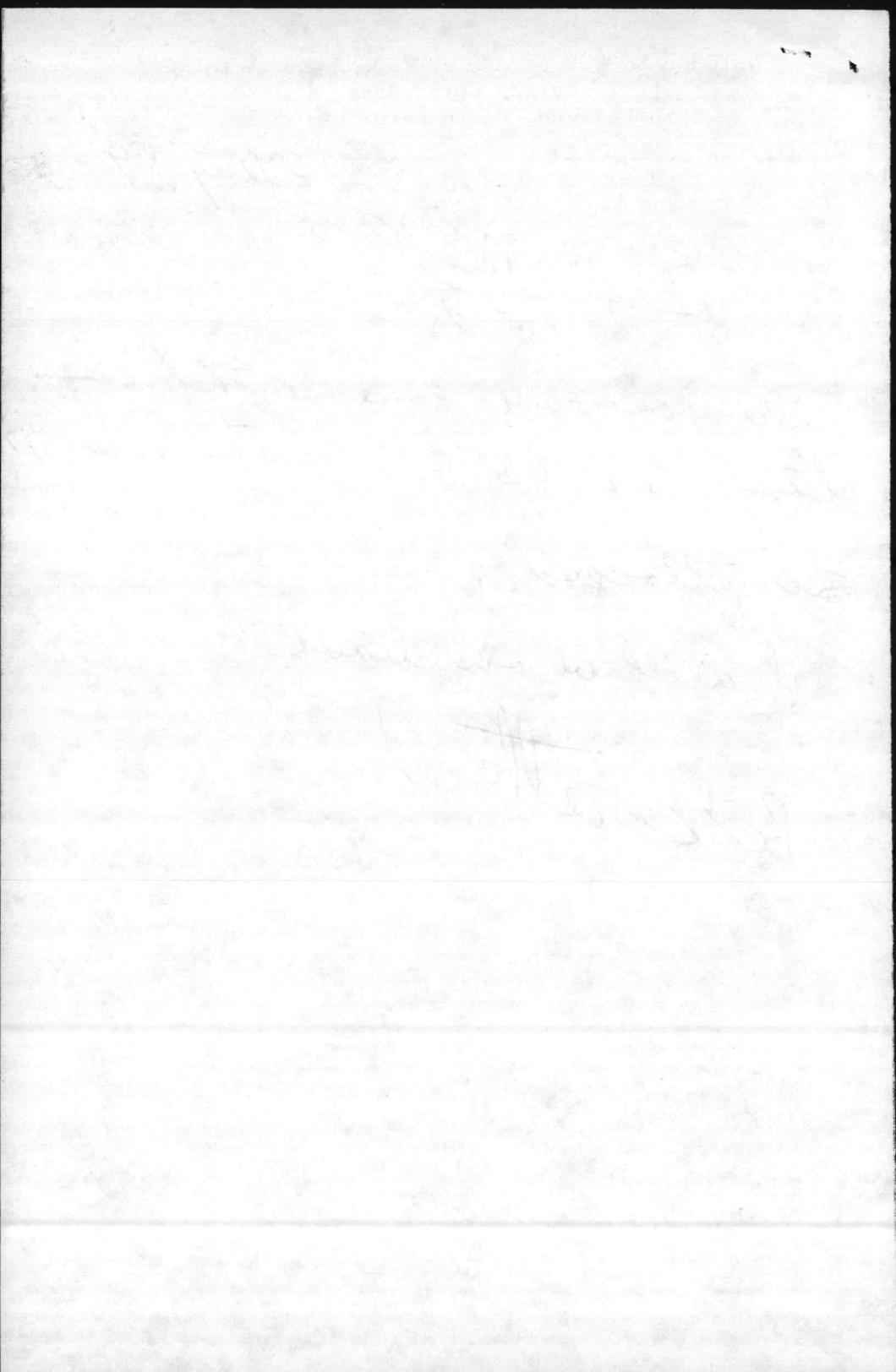
Subj:

Do you have someone that can attend the U.S. GS meeting 4 Aug 89?

See attached.

I will be on leave

but attend





UNITED STATES MARINE CORPS
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA 28542-5001

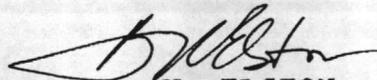
IN REPLY REFER TO:

6280/9
FAC

JUL 31 1989

From: Commanding General, Marine Corps Base, Camp Lejeune, North Carolina 28542-5001
To: Commanding Officer, Marine Corps Air Station, New River
Public Works Officer
Base Maintenance Officer
→ Director, Natural Resources and Environmental Affairs Division
Subj: PRESENTATION OF GROUNDWATER STUDY BY U. S. GEOLOGICAL SURVEY (USGS)

1. Request a representative from your office attend the subject meeting scheduled for 0900, 4 August 1989, at the Hadnot Point SNCO Club, Building 425. The purpose of the presentation is to update all parties on progress to date of this important study.
2. At this briefing, USGS will describe the aquifer characteristics and discuss relationship between water supply operations and future developments and ongoing contamination issues. Plans for final study efforts, which will also be presented, include development of a groundwater management model.
3. Point of contact is Bob Alexander, extension 3034.


B. W. ELSTON
By direction

Memorandum

DATE: 17 April 1987

FROM: Environmental Control Specialist

TO: The Record, NREAD

VIA: Supervisory Chemist and Base Eco

SUBJ: In Progress Review of Groundwater
USGS.

For Betsy CB

Danny DDS

Wooten JW

File at LAB
DDS

May 8th

1. On Thursday morning, April 16 at 1000, a meeting in the Conference Room of Bldg-1.
2. The USGS people presented data gathered to complete Phase 1, the preliminary assessment of the hydrogeologic framework beneath Camp Lejeune. Their report on Phase 1 will be forthcoming in late April or May.
3. The bottom line for Camp Lejeune is ensuring a plentiful and contamination-free supply of drinking water. Hopefully, work being done by ESE, USGS, and NC DEN will provide Camp Lejeune personnel with necessary information to make proper decisions to do just that.
4. Concerns were voiced by Carl Baker, Mark Frazelle, and Al Austin about subjects as contractor not delivering expected quantities of drinking water in production wells and THM's in MCAS(H) drinking water. Rick Shover stated that MCL's for THM's would be increased in the future(?).

Betsy:
Please find out
his Authority
D. Baker

5. Those in attendance were:

USGS Doug Harned
 Ron Coble
 Bob Lloyd

NCDEM Rick Shiver

ESE Mike ?

MCB, CL Col. Kiniasopolos
 Al Austin
 Carl Baker
 Bds Alexander
 Mads Frazelle
 Mary Wheat
 Tom Barber

Memorandum

DATE: 17 April 1987

FROM: Environmental Control Specialist

TO: The Record, NREAD

VIA: Supervisory Chemist and Base Ecologist

SUBJ: In Progress Review of Groundwater Resources Study by
USGS.

1. On Thursday morning, April 16 at 1000, I attended the meeting in the Conference Room of Bldg-1.
2. The USGS people presented data gathered to complete Phase 1, the preliminary assessment of the hydrogeologic framework beneath Camp Lejeune. Their report on Phase 1 will be forthcoming in late April or May.
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*Betz:
Please send out
his Authority
D. Star*
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(OVER)

5. Those in attendance were:

USGS
Doug Harned
Ron Coble
Bob Lloyd

NCDEM
Rick Shiver

ESE
Mike ?

MCB, CL
Col. Kiniasopolos
Al Austin
Carl Baker
Bds Alexander
Mads Frazelle
Mary Wheat
Tom Barber

16 APRIL 87

WORK PLAN FOR PHASE 1
(April 1, 1986 - April 1, 1987)

Work items to be accomplished during Phase 1 will be based almost entirely on existing data.

WORK TASK I Compile all available ground-water data from USGS, State, and Camp Lejeune files for the area, including water-level, water-quality, water-use, and well-log data. Construct a computer data set of this data that will facilitate future statistical analysis.

- a. Compile USGS data sources.
- b. Compile N.C. Department of Natural Resources and Community Development data sources.
- c. Compile Camp Lejeune data resources.
- d. Inventory existing wells, take water-quality samples, and evaluate field parameters including chloride concentration, bromide concentration, pH, temperature, dissolved oxygen, specific conductance.

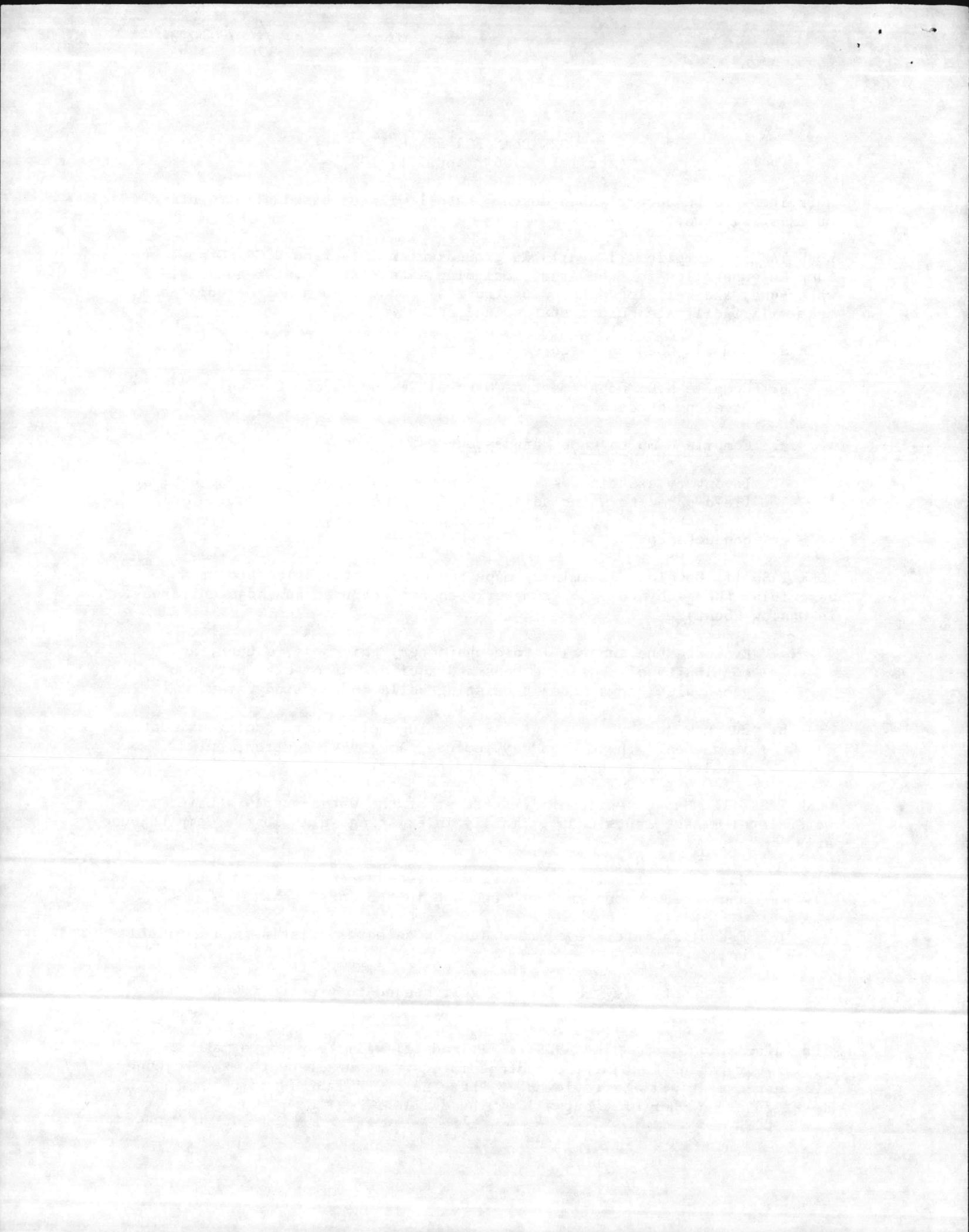
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- a. Evaluate the general lithic character, thickness, extent, and continuity of confining beds and aquifers, from examination of geophysical logs made in existing wells in the study area.
- b. Run new geophysical logs for existing wells where additional data is needed. These logs may include gamma-ray, neutron, bulk density, sonic gravel-time, and caliper logs.

WORK TASK III Map potentiometric surfaces of the water-supply aquifer from water-level measurements made primarily in existing wells in the Camp Lejeune area.

- a. Make two sets of water-level measurements in wells and local creeks and streams, one in "wet" and one in the "dry" season.
- b. Establish water-level recorders on selected existing and available wells.
- c. Construct a few shallow wells if needed to prepare a water-table map.

The information from WORK TASKS I, II, and III will be used to make a preliminary assessment of the hydrogeologic framework beneath Camp Lejeune. This assessment will be reviewed in Phase 2a (WORK TASK I) to determine the location and number of test wells to be drilled.



now ongoing

WORK TASK IV Prepare report on the results of the Phase 1 investigations with appropriate illustrations and data tables. The proposed title of the Phase 1 report is "A preliminary geohydrologic framework of the Camp Lejeune Marine Corps Base area, N.C."

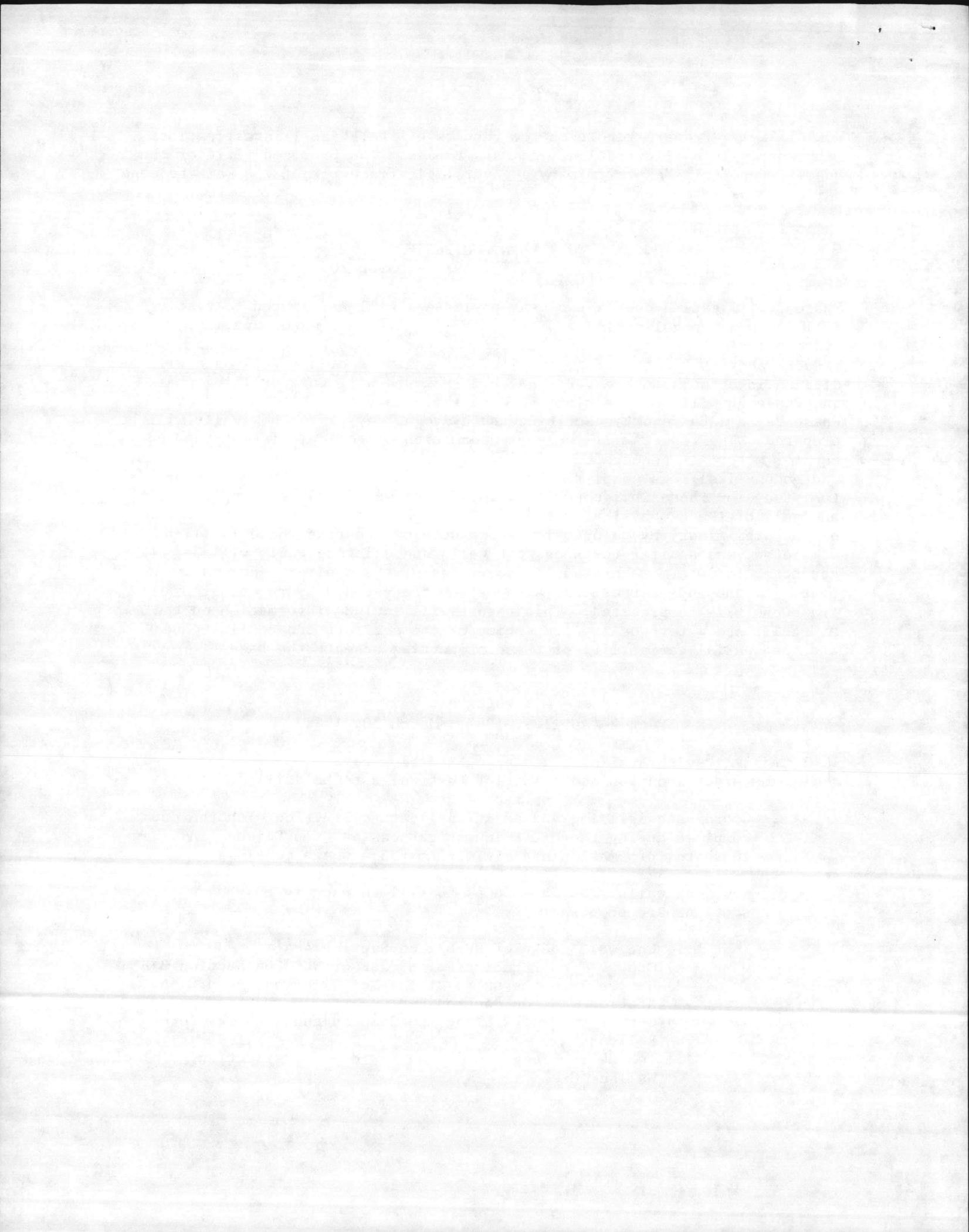
WORK PLAN FOR PHASE 2
(Years 2 and 3 (April 1, 1987 - March 30, 1989))

Phase 2 will extend over a two-year period and will be devoted to test drilling and the collection and analysis of additional water quality, hydrogeologic, and aquifer hydraulic-parameter data. The work tasks associated with the drilling, testing, and analysis of new well data will be divided into two subphases, 2a and 2b. Phase 2a will be a drilling phase and Phase 2b will be a testing and data-analysis phase. At the end of Phase 2a, a data report describing the hydrogeology of the new wells will be prepared. The report will include information on geologic formations and aquifer materials penetrated by the test wells, water quality in the wells, and geophysical logs completed by the end of 2a. During the third year of the study, or Phase 2b, geophysical logging of wells will be completed, analysis of the geophysical logs will be completed, editing and refinement of the preliminary hydrologic framework developed during Phase 1 will be completed, and aquifer tests on test wells and existing wells will be conducted to determine hydraulic properties of the aquifers and confining beds. At the end of Phase 2b, a report on the revised hydrogeologic framework will be prepared. This report will include information on the hydraulic and water-quality properties of the aquifers and confining beds and the spatial variability of these properties beneath the base.

PHASE 2a
Year 2 (April 1, 1987 - March 30, 1988)

WORK TASK I Review available geologic, hydrologic, and chemical data and determine exact location and number of test wells to be drilled.

- a. Coordinate drilling and additional data collection with the data compiled during the NACIP investigations at Camp Lejeune in order to share information and minimize expense where possible.
- b. New test wells (200 feet deep) to fill in gaps in the Phase I cross sections are proposed:
 - 1) One well south of HP-632 on Section A-A'
 - 2) One well on Paradise Point east of NW-3 on Section B-B'
 - 3) One well on the shore of the New River on the M.C. Air Station side on Section B-B'
 - 4) One or two wells along the Camp Lejeune--Cherry Point Railroad
 - 5) Two wells along a proposed new dip Cross Section paralleling Wallace Creek



Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the freshwater-saltwater interface and its relation to supply-well pumping in the M.C. Air Station area.

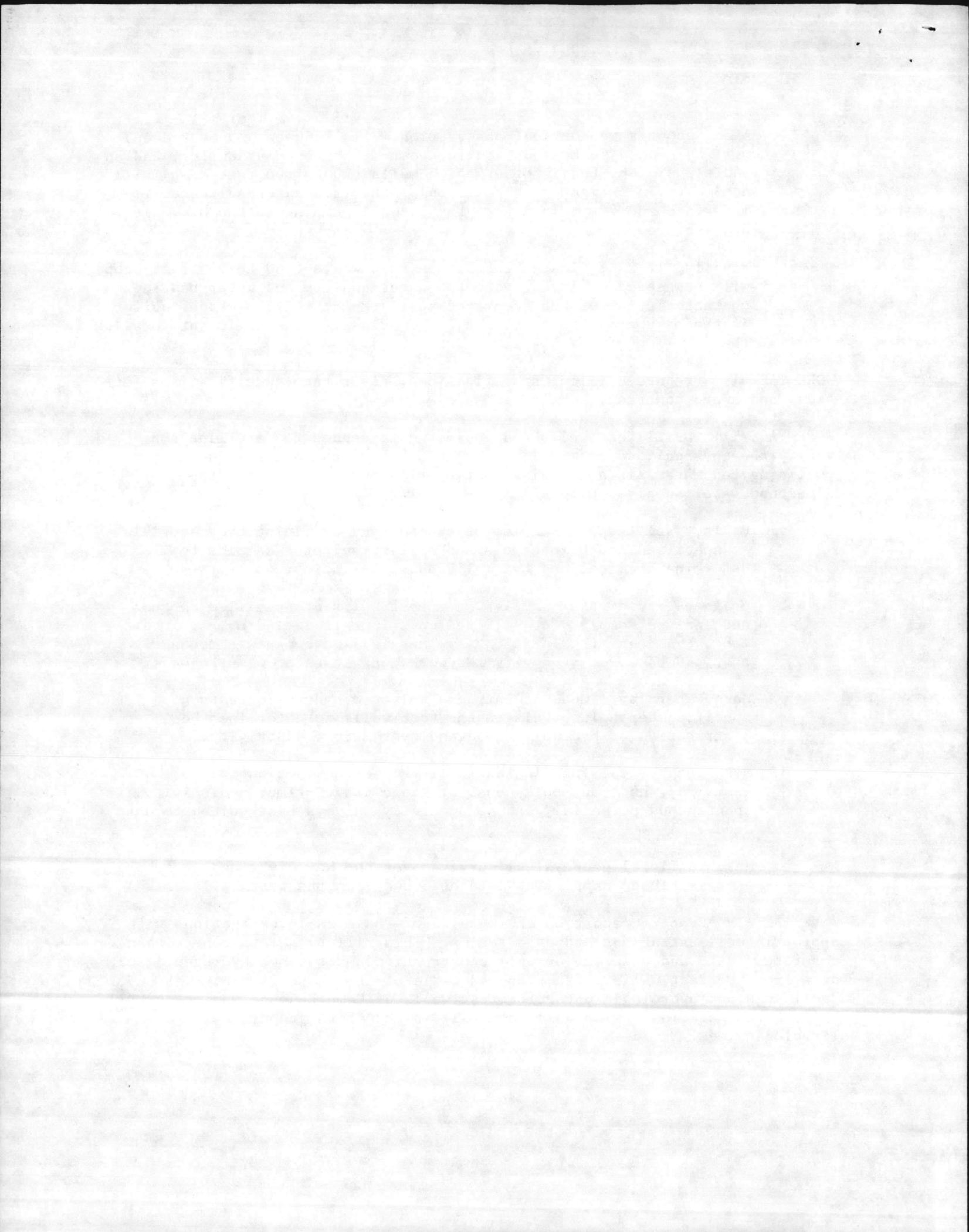
Finally, it is estimated that three test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area, however, project funding is not sufficient to allow the drilling of these wells (April 1987).

WORK TASK II Prepare drilling specifications, distribute specifications for bids, and award contract.

WORK TASK III Drill test wells and collect data needed to determine and verify the physical and chemical characteristics of the aquifer and confining-bed materials and fluids that overlie and occur within the deep, limestone water-supply aquifer.

- a. Collect split-spoon samples of aquifer and confining-bed materials at specified depth intervals and analyze selected samples to determine chemical and hydraulic characteristics.
- b. Collect ground-water samples from test wells at specified depths and analyze samples for selected constituents including concentrations of chloride, heavy metals, and organic compounds that can be associated with the work activities at Camp Lejeune.
- c. Make water-level measurements and selected hydraulic tests at specified depth intervals in the test wells to determine the distribution of hydraulic head and hydraulic conductivity.
- d. Make geophysical logs in test wells selecting combinations of gamma-ray, neutron, bulk density, sonic travel-time, resistivity, spontaneous potential, and conductivity surveys best suited to data needs.
- e. Make surficial geophysical surveys over the New River and elsewhere as feasible to supplement data obtained from the test wells.

WORK TASK IV Prepare report on the results of Phase 2a investigations with appropriate illustrations and data tables. This will be a data report that describes test- and observation-well construction and the new hydrogeologic data from the test wells. The proposed title of the Phase 2a report is "Well logs and hydrologic data from test wells at Camp Lejeune Marine Corps Base, North Carolina." The well logs will include both geophysical and lithologic logs.



PHASE 2b
Year 3 (April 1, 1988 - March 30, 1989)

WORK TASK I Complete drilling, sampling, and hydraulic tests of test wells. (This is first priority work item if drilling and testing of test wells was not completed during Phase 2a or if the drilling of additional wells became necessary.)

WORK TASK II Complete geophysical logging of new and existing wells. Analyze logs.

- a. Analyze the geophysical and lithologic logs to identify depths to aquifer units and confining beds.
- b. Construct fence diagrams to determine the lateral extent of aquifer units and confining beds.

WORK TASK III Conduct aquifer tests on new and existing wells to determine hydraulic properties of aquifer unit(s) and confining beds.

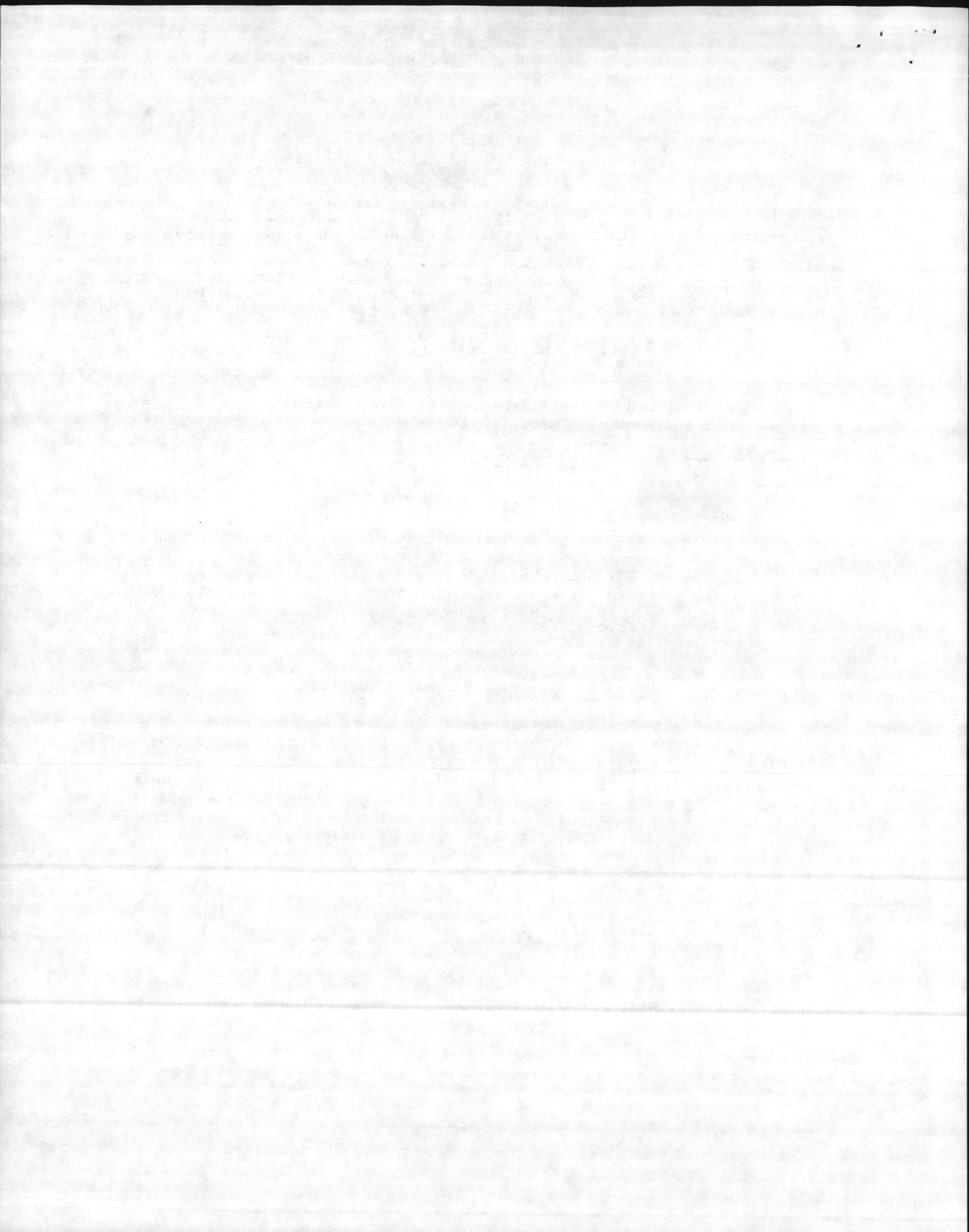
WORK TASK IV Based on new findings, refine and edit the preliminary assessment of the hydrogeologic framework that was developed during Phase 1.

WORK TASK V Prepare a report that describes the refined hydrogeologic framework. The proposed title of the phase 2b report is "Hydrogeologic framework beneath Camp Lejeune Marine Corps Base, North Carolina."

WORK PLAN FOR PHASE 3
Year 4 (April 1, 1989 - March 30, 1990)

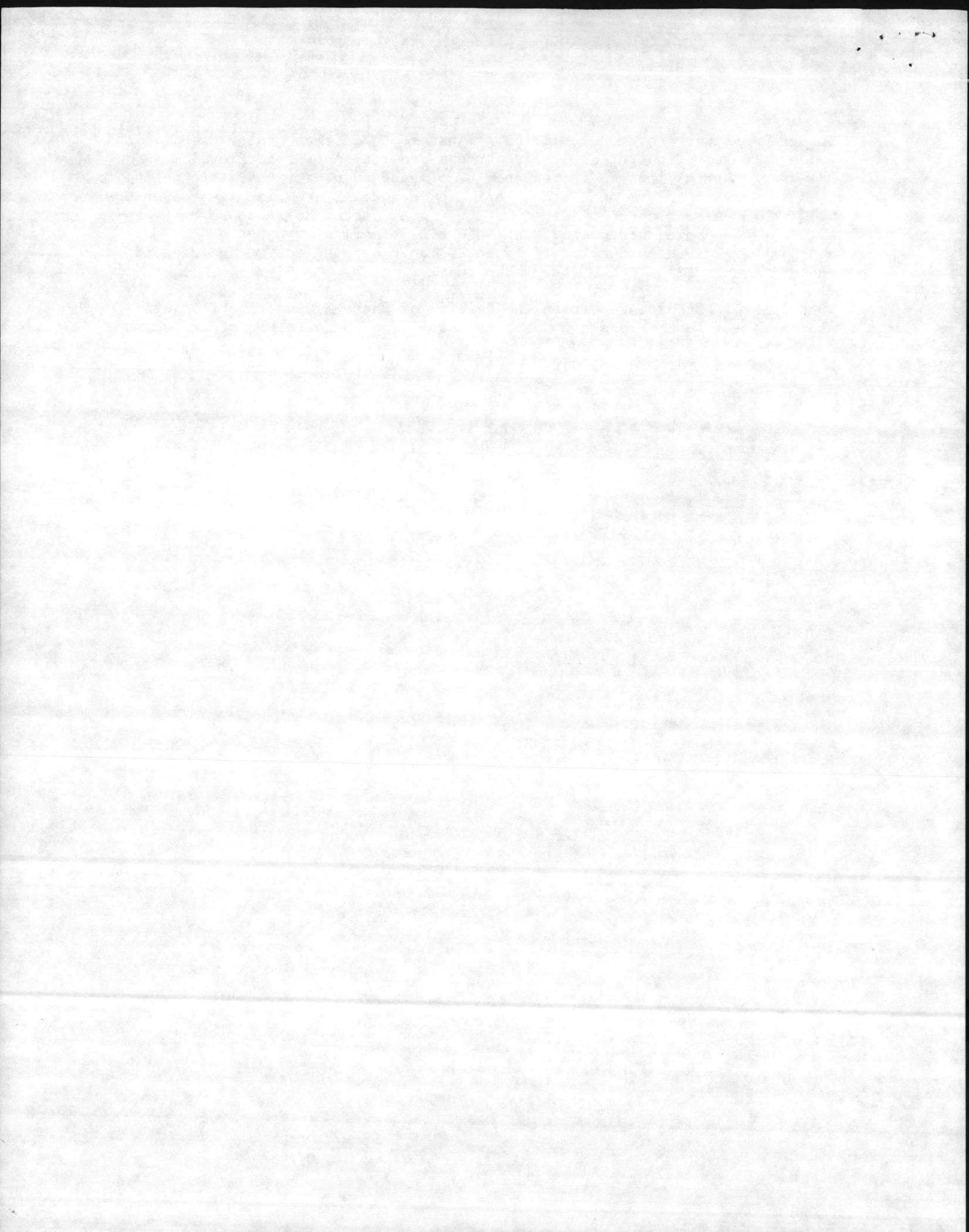
WORK TASK I Construct a finite-difference ground-water flow model of the hydrogeologic system in and around Camp Lejeune based on the data and interpretations that resulted from investigations during Phases 1 and 2.

- a. Determine grid system for area and discretize appropriate maps of aquifer and confining-bed characteristics (such as structure tops, thicknesses, hydraulic conductivity, potentiometric surfaces, etc.).
- b. Determine boundary conditions.
- c. Develop a steady-state digital model for unstressed (pre-pumping) conditions in the area.
- d. Evaluate different ground-water pumpage and development schemes to determine which alternatives will reduce the chances for contamination of the water-supply aquifer (optimization analysis).



The ground-water flow model will be a management aid that can be used (1) to guide site selection for new wells through prediction of water-level drawdowns that will occur in response to planned pumping rates at potential well sites, and (2) to evaluate water-level drawdowns at existing production wells through prediction of drawdowns that would occur in response to alternative pumping schedules. The potential benefits to be gained from model studies are less well interference, lower pumping costs, and reduced chance for contamination of the water supply.

WORK TASK II Prepare report on the results of Phase 3 investigations with appropriate illustrations and data tables. The proposed title of the Phase 3 report is "Ground-water supply and potential for contamination--Camp Lejeune Marine Corps Base, North Carolina."



JLW *Danny* *DDS*

Betz: Someone Needs to Attend

Tom
CAN YOU ATTEND?

6280/9
FAC
APR 03 1987

North Carolina Department of
Environmental Management
Attn: Mr. Rick Shiver
7225 Wrightsville Avenue
Wilmington, North Carolina 28403-3969

Re: Groundwater Resources Study by
U.S. Geological Survey

Dear Mr. Shiver:

You are invited to participate in an in-progress review of the subject study scheduled April 16, 1987. The meeting will be held at 10:00 a.m. in the Building 1 Conference Room.

We are nearing completion of Phase I of the study which documents the extent of our knowledge of the aquifer serving the Camp Lejeune complex. The U.S. Geological Survey will present an overview of this groundwater and geologic data in preparation for Phase II, which defines aquifer properties through test well drilling. Phase II plans will also be previewed.

Please contact Mr. Bob Alexander, Marine Corps Base Environmental Engineer, at (919) 451-3034 for further information on this review.

Sincerely,

T. J. DALZELL
Colonel, U.S. Marine Corps
Assistant Chief of Staff, Facilities
By direction of the Commanding General

Copy to:
N.C. Division of Health Services
U.S.G.S., Raleigh, NC
CMC (LFL)
NAVFACENGCOM (Code 114)
Environmental Science & Engineering,
Gainesville, FL

Blind copy to:
CO, MCAS, NR (Attn: S-4)
BMO
PWO
NREAD
EnvEngr



1981 2 138A

Meeting: 16 April 87

Overview of Phase I given by USGS.

Water level survey hi and lo

Daugharned, USGS

C.L. aquifer is Castle Hayne

Well Survey was first work step done.

(used existing wells (some by VPI off the base))

UNC has study sites at TT - gas station.

NC52 Camp Geism

Records Stations - TT 53 } Recordem, USGS

- HP 630

- RR 97

- Fire Tower at Dixon (Folkstone Station)

* Groundwater Recharge Information
Tide Gauge at HP (Paradise Point)

Data from base on water use.

1975-1986 6-8 mgd.

Production well construction can determine efficiency.

Strato - limestone, sand determine capacity and ease of withdrawal of water.

Importance of geophysical logs: helps contractor set depth of well screens. Our new wells don't have the logs.

Briefed on Phase 2 work via handout.

Mack Frazzelle expressed concern about T+M's at MCAS.
Shiner noted T+M MCL's would prob. be increased some
time in the future. (?)

In Attendance:

USGS : Ron Coble
Bob Lloyd
Doug Harned

NCDEM : Rick Shiner

ESE : Mike ?

MCB, CL: Carl Baker
Mack Frazzelle
Col. Kiriacopolous
Al Austin
Bob Alexander
Mary Wheat
Tom Barber



DEPARTMENT OF THE NAVY

ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511-6287

TELEPHONE NO.

(804) 445-2930

IN REPLY REFER TO:

6280

1141JJH

25 SEP 1986

From: Commander, Atlantic Division, Naval Facilities Engineering Command
To: Commanding General, Marine Corps Base, Camp Lejeune

Subj: COMMENTS ON U.S. GEOLOGICAL SURVEY (USGS) PROPOSAL TO STUDY THE WATER
AQUIFER

Ref: (a) MARCORB Camp Lejeune ltr 6280/4 FAC of 5 Sep 85 (subj: Requesting
Comments on USGS proposal)

1. The USGS proposal is for an ambitious aquifer study program which will be part of North Carolina's and the USGS's effort in studying the groundwater. Marine Corps concerns are groundwater contamination and an adequate potable water supply for the future.

While both the USGS and the Marine Corps concerns are for the groundwater, the extent and depth of the studies needed to satisfy each need are different. The USGS proposal would have the Marine Corps fund a study suited for the USGS goals, but considerably beyond the needs of the Marine Corps.

2. Based on the project proposal, there appears to be some overlap between the USGS study and the NACIP Confirmation Study being conducted by Environmental Science and Engineering, Inc. The chemical tests described under Phase II will be performed by ESE on composite samples from all existing wells in October 1986. Should any parameters exceed analytical detection limits or Maximum Contaminant Levels, as applicable, individual wells will be sampled for that contaminant. USGS Phase III goal of determining alternative groundwater use and management practices to reduce the chances for contamination is also being addressed by the NACIP program. At the conclusion of the Confirmation Study, ESE will have evaluated the potential for both horizontal and vertical contaminant migration from each site under study. If the potential exists for contaminant migration into your water supply aquifer, they will look at remedial alternatives, which may include changes in your groundwater use and management practices. As you are aware, ESE will commence this extensive investigation for the Hadnot Point water supply aquifer this fall.

3. Adequacy of the water supply is determined by pump tests to determine aquifer capacity and analyses of groundwater samples to determine quality. Three or four tests, properly performed, should provide adequate aquifer data to estimate the water supply potential. These could be done at the existing water wells at a considerably lower cost than the USGS proposal.

Cost/well (estimate)

Remove Marine Corps pump, inspect the pump and make minor
adjustments/repairs and replace after test 350.00



Subj: COMMENTS ON U.S. GEOLOGICAL SURVEY (USGS) PROPOSAL TO STUDY THE WATER
AQUIFER

Install test pump and perform test	6,000.00
Drill 1-1/4 inch Observation Well at \$18.50/feet	<u>3,650.00</u>
Total	\$10,000.00/well
5 well tests	= 50,000.00
Contingencies at 10 percent	= 5,000.00
Escalated to 1987 at 10 percent	= <u>5,000.00</u>
Total	=\$60,000.00

Well test analyses can be done in-house by LANTNAVFACENCOM using the modified
Theis Method.

4. Salt water intrusion can be determined by periodically sampling the chloride levels at various depths of some of the existing wells near and away from the ocean. The intrusion rate can be estimated by dividing the difference of the distances of two wells from the coastline by the time required for the chloride concentration of the furthest well to reach the chloride concentration that existed in the closest well when the sampling began.

5. While a groundwater model such as proposed may be useful for the large area USGS groundwater type of study, other more economical methods are available to determine groundwater draw down levels induced by Marine Corps pumping over a period of time.

6. A simple network program based upon the Theis equation that can be run on a desktop PC Computer with user instructions could be developed by this office. This should be adequate for Marine Corps needs. New well locations can be evaluated and drilled where the computer model indicates drawdowns would be smallest. Well pumping routines simulated on the computer showing those wells that produce the minimum drawdowns and can be selected for well pump operation.

J. R. Bailey
J. R. BAILEY
By direction

7



DEPARTMENT OF THE NAVY
OFFICE OF INFORMATION
WASHINGTON, D.C. 20350

IN REPLY REFER TO

4602
OI-511

31 JAN 1985

MEMORANDUM FOR AREA COORDINATORS

Subj: PUBLIC AFFAIRS GUIDANCE--HAZARDOUS WASTE SITE CLEANUP

Ref: (a) OPNAVINST 5090.1

1. The Navy Assessment and Control of Installation Pollutants (NACIP) program detailed in reference (a), paragraph 11202.C, is a three phase nationwide process to identify Navy past hazardous waste sites and take necessary cleanup action. The first phase (Initial Assessment Study) is an exhaustive search of historical records, employee interviews, and surface observations, to determine what may have been dumped and where. In the second phase (Confirmation Study), the characteristics of the ground water, contamination (if present), and environmental effects are determined, and any necessary remedial measures recommended. The third and final phase (Remedial Action) consists of necessary clean up actions. The activity involved provides all studies to the Environmental Protection Agency (EPA) and state agencies, and their coordination and advice are sought before proceeding to the next phase.
2. Consistent with the policy of keeping legitimately interested parties informed, it is the policy of the Department of the Navy to provide completed studies to the media, as well as local organizations on request. In this regard, the following guidance is provided:
 - a. Completed studies should be released as soon as practical upon request. The activity CO, working with the area coordinator or his designated representative, is responsible for this release. Copies of studies are available from the activity which is the subject of the study.
 - b. CHINFO Plans and Policy Division (OI-5) (Commercial 202-697-7371/Autovon 227-7371) is to be informed of the release of these documents.
 - c. Commanders are encouraged to discuss NACIP studies and remedial cleanup with the media and local organizations within their areas of responsibility. The following points will be emphasized:
 - (1) The Navy is concerned about the environment. We will continue to pursue action to take remedial action to clean up pollutants.

1951
01-214

WATER SITE CLEANUP

The first phase of the cleanup operation is the removal of debris and other floating material from the water surface. This is being done by hand and by the use of floating booms. The second phase is the removal of oil and other pollutants from the water column. This is being done by the use of skimmers and other specialized equipment. The third phase is the removal of pollutants from the bottom of the water body. This is being done by the use of suction dredges and other specialized equipment. The fourth phase is the treatment of the water to remove any remaining pollutants. This is being done by the use of activated carbon and other specialized equipment. The fifth phase is the monitoring of the water quality to ensure that the cleanup operation is successful and that the water is safe for use.

The following table lists the various activities being carried out as part of the cleanup operation. The activities are listed in order of priority, with the most important activities listed first. The activities are: 1. Removal of debris and other floating material from the water surface. 2. Removal of oil and other pollutants from the water column. 3. Removal of pollutants from the bottom of the water body. 4. Treatment of the water to remove any remaining pollutants. 5. Monitoring of the water quality to ensure that the cleanup operation is successful and that the water is safe for use.

The following table lists the various activities being carried out as part of the cleanup operation. The activities are listed in order of priority, with the most important activities listed first. The activities are: 1. Removal of debris and other floating material from the water surface. 2. Removal of oil and other pollutants from the water column. 3. Removal of pollutants from the bottom of the water body. 4. Treatment of the water to remove any remaining pollutants. 5. Monitoring of the water quality to ensure that the cleanup operation is successful and that the water is safe for use.

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Subj: PUBLIC AFFAIRS GUIDANCE--HAZARDOUS WASTE SITE CLEANUP

(2) Past hazardous waste disposal methods, although acceptable at the time, have often caused problems as long term characteristics of pollutants and land disposal became known.

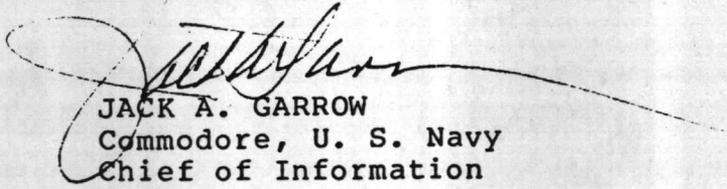
(3) State and local agencies will be notified promptly by local Navy officials if health, welfare or environmental problems are identified--even before publication of final technical reports.

(4) If an immediate hazard to human health or the environment is identified, remedial action will begin immediately.

3. Questions from the media or local organizations beyond this guidance or national in scope should be referred as follows:

a. Media queries to CHINFO News Desk (Commercial 202-697-5342/Autovon 227-5342).

b. Public affairs policy questions to CHINFO Plans and Policies Division (Commercial 202-697-7371/Autovon 227-7371).


JACK A. GARROW
Commodore, U. S. Navy
Chief of Information

Copy to:
CHINFOSTAFFINST 5216.1F, List D, Part 1
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DEPARTMENT OF THE NAVY

ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511-6287

WQCL For Appropriate
Action Original sent
To ACIS FAC 2 hrms 30 Oct 86

TELEPHONE NO.

(804) 445-2930

IN REPLY REFER TO:

6280

1141JJH

25 SEP 1986

From: Commander, Atlantic Division, Naval Facilities Engineering Command
To: Commanding General, Marine Corps Base, Camp Lejeune

Subj: COMMENTS ON U.S. GEOLOGICAL SURVEY (USGS) PROPOSAL TO STUDY THE WATER
AQUIFER

Ref: (a) MARCORB Camp Lejeune ltr 6280/4 FAC of 5 Sep 85 (subj: Requesting
Comments on USGS proposal)

1. The USGS proposal is for an ambitious aquifer study program which will be part of North Carolina's and the USGS's effort in studying the groundwater. Marine Corps concerns are groundwater contamination and an adequate potable water supply for the future.

While both the USGS and the Marine Corps concerns are for the groundwater, the extent and depth of the studies needed to satisfy each need are different. The USGS proposal would have the Marine Corps fund a study suited for the USGS goals, but considerably beyond the needs of the Marine Corps.

2. Based on the project proposal, there appears to be some overlap between the USGS study and the NACIP Confirmation Study being conducted by Environmental Science and Engineering, Inc. The chemical tests described under Phase II will be performed by ESE on composite samples from all existing wells in October 1986. Should any parameters exceed analytical detection limits or Maximum Contaminant Levels, as applicable, individual wells will be sampled for that contaminant. USGS Phase III goal of determining alternative groundwater use and management practices to reduce the chances for contamination is also being addressed by the NACIP program. At the conclusion of the Confirmation Study, ESE will have evaluated the potential for both horizontal and vertical contaminant migration from each site under study. If the potential exists for contaminant migration into your water supply aquifer, they will look at remedial alternatives, which may include changes in your groundwater use and management practices. As you are aware, ESE will commence this extensive investigation for the Hadnot Point water supply aquifer this fall.

3. Adequacy of the water supply is determined by pump tests to determine aquifer capacity and analyses of groundwater samples to determine quality. Three or four tests, properly performed, should provide adequate aquifer data to estimate the water supply potential. These could be done at the existing water wells at a considerably lower cost than the USGS proposal.

Cost/well (estimate)

Remove Marine Corps pump, inspect the pump and make minor
adjustments/repairs and replace after test 350.00



Subj: COMMENTS ON U.S. GEOLOGICAL SURVEY (USGS) PROPOSAL TO STUDY THE WATER
AQUIFER

Install test pump and perform test	6,000.00
Drill 1-1/4 inch Observation Well at \$18.50/feet	<u>3,650.00</u>
Total	\$10,000.00/well
5 well tests	= 50,000.00
Contingencies at 10 percent	= 5,000.00
Escalated to 1987 at 10 percent	= <u>5,000.00</u>
Total	=\$60,000.00

Well test analyses can be done in-house by LANTNAVFACENCOM using the modified
Theis Method.

4. Salt water intrusion can be determined by periodically sampling the chloride levels at various depths of some of the existing wells near and away from the ocean. The intrusion rate can be estimated by dividing the difference of the distances of two wells from the coastline by the time required for the chloride concentration of the furthest well to reach the chloride concentration that existed in the closest well when the sampling began.

5. While a groundwater model such as proposed may be useful for the large area USGS groundwater type of study, other more economical methods are available to determine groundwater draw down levels induced by Marine Corps pumping over a period of time.

6. A simple network program based upon the Theis equation that can be run on a desktop PC Computer with user instructions could be developed by this office. This should be adequate for Marine Corps needs. New well locations can be evaluated and drilled where the computer model indicates drawdowns would be smallest. Well pumping routines simulated on the computer showing those wells that produce the minimum drawdowns and can be selected for well pump operation.

J. R. Bailey
J. R. BAILEY
By direction



Project Report - April 1986 - January 1987

INVESTIGATION NC 00-084: An appraisal of the ground-water resources of Camp Lejeune Marine Corps Base, N.C.

PERIOD OF INVESTIGATION: 1986-89

INVESTIGATION CHIEF: Douglas A. Harned, U.S. Geological Survey, Box 2857, Raleigh, N.C., 27602, FTS 672-4791, 919-856-4791

COOPERATOR: Federal

OBJECTIVE: The objectives of this study are: to describe the ground-water resources of the Base and environs and to construct an appropriate ground-water flow model that will be used to evaluate alternative ground-water use and management practices. This is a three-phased study: the first phase is examination of available data, the second phase is collection of additional data and construction of new observation wells, and the third phase is modelling.

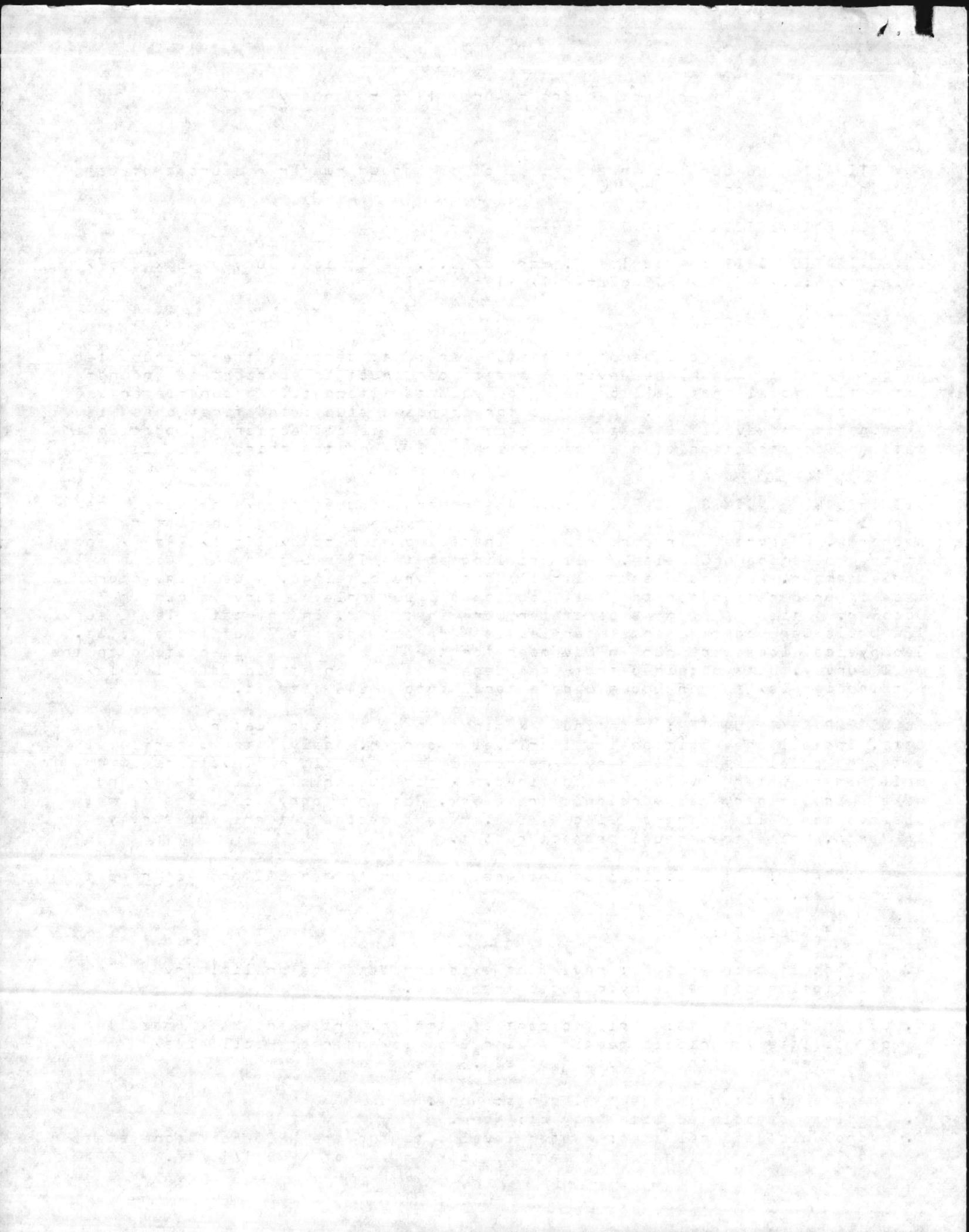
SIGNIFICANT FINDINGS AND PROGRESS: A stream-gaging station, and a rain gage were installed in the Town Creek basin to provide data on ground-water recharge. Water-level recorders were installed at HP-630, TT-53, RR-97, and at the Folkstone NRC site. Well drilling at the Camp Lejeune NRC site began in September. Water-use and well-file data were obtained. A well inventory was made in preparation for the well logging and water-level surveys run in October. A tide gage and a barometer were installed. In the water level survey 127 wells were checked and water levels were obtained at 76 of those wells. Geophysical logs were run in November for the 16 open wells identified in the well survey. Data obtained from Camp Lejeune files on static water levels, pumping levels, and drawdown were entered into a SAS dataset.

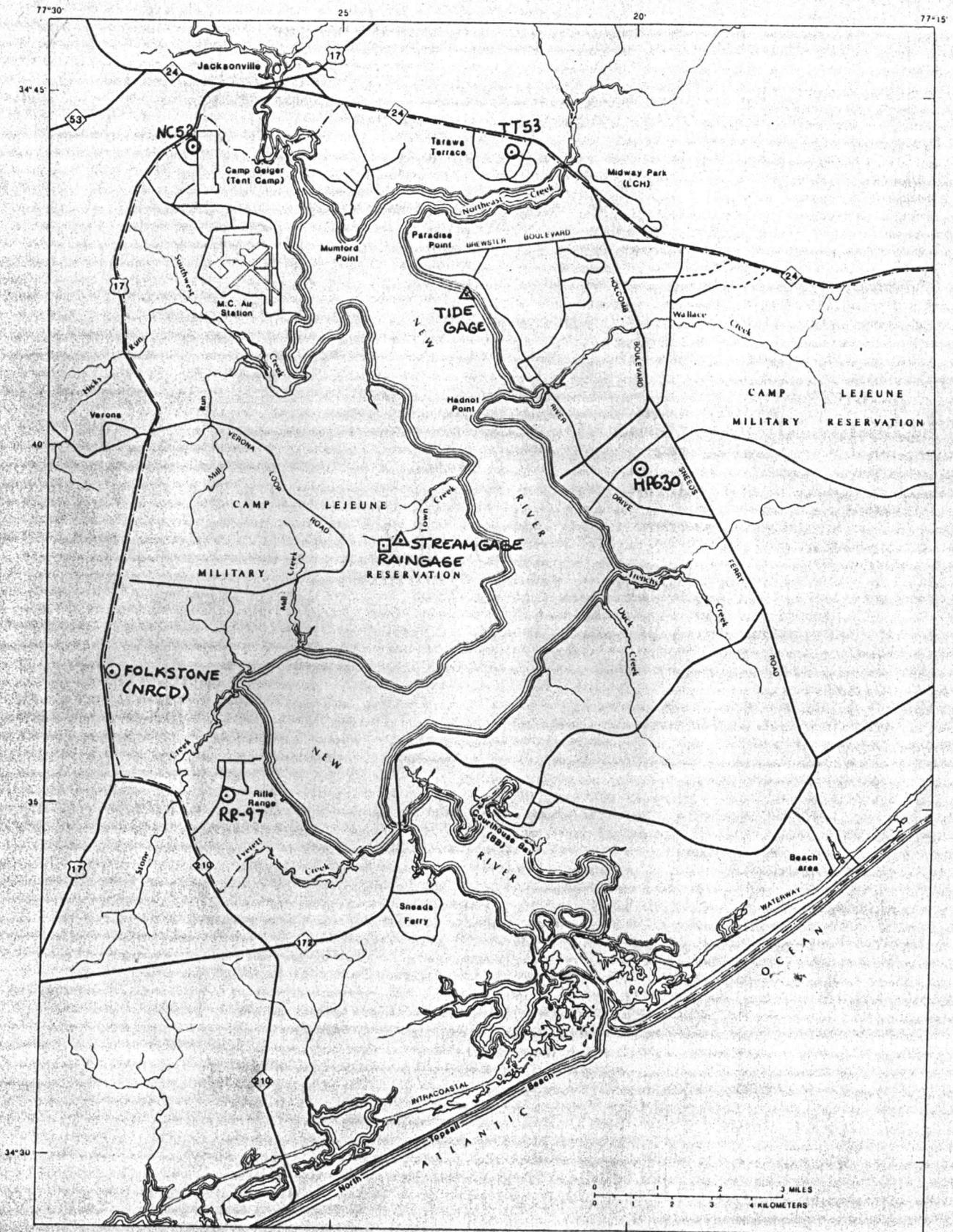
PLANS FOR NEXT QUARTER: Continue examination of existing water use and well data. Install one additional water-level recorder. Analyze the water-level data and develop a preliminary water-level map. Establish elevations of the 76 wells where water levels were obtained. Examine geophysical log data, and make a preliminary geohydrologic framework. Obtain geophysical logs of new observation wells being drilled by ESE. Make a second water-level survey in March. Write the annual project report.

REPORT STATUS: Data collection and analysis for the annual project report is underway.

PROJECT HIGHLIGHTS:

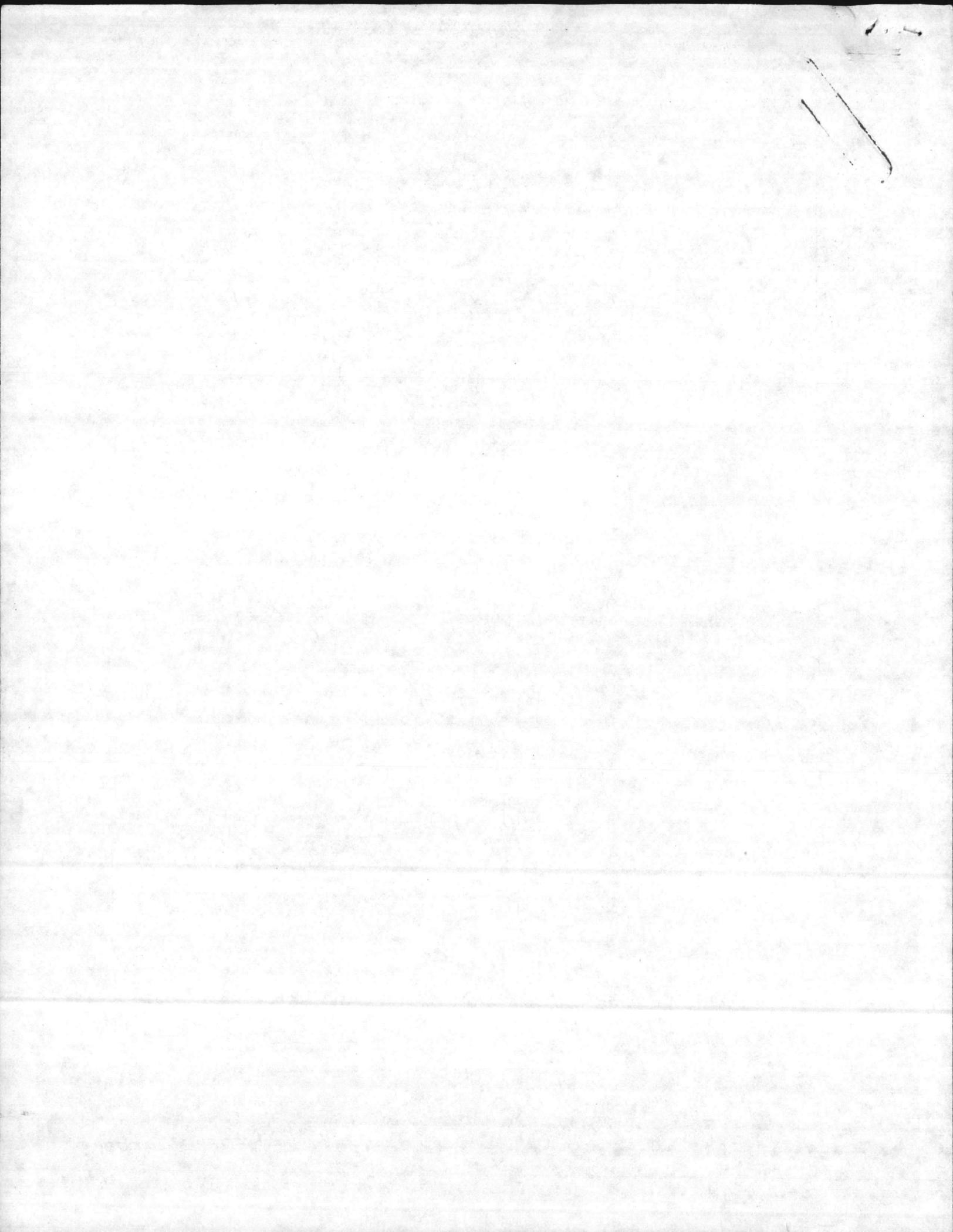
- A. Project stage: Phase I: review of existing data and preliminary description of the geohydrologic framework.
- B. Cooperator Contacts: Periodic contact with Mr. Price and Mack Frazelle of Utilities, periodic meetings with Bob Alexander of Facilities, and a meeting with Mike Geden of ESE.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: Water level data for the NRC Folkstone station and 16 Gamma-ray log copies sent to Rick Shiver of NRC 1/16/87.





Base taken from Defense Mapping Agency Hydrographic Center,
Camp Lejeune Special Map, 1:50,000

Locations of U.S. Geological Survey water-level recorders (Folkstone, RR-97, HP630, TT53, and NC52), stream gage, tide gage and rain gage.



Dang *DL*

Betz *EB*

Return to NREAD

T-6243/A
6280/4
FAC

1986

Assistant Chief of Staff, Facilities, Marine Corps Base, Camp
Lejeune
Assistant Chief of Staff, Comptroller

GROUNDWATER SUPPLY STUDY BY U.S. GEOLOGICAL SURVEY, PHASE I

Ref: (a) CMC (LFL) msg 07013Z Feb 86

incl: (1) Project Proposal, U.S.G.S. dtd 14 Aug 85
(2) Cost Account Information

1. Request funding IAO \$80K be transferred to the U. S. Geological Survey, Raleigh, NC to initiate Phase I of the subject study as described in the enclosures. The reference approved funding for this effort.
2. The purpose of the study is to determine groundwater use and management practices in order to reduce potential for future contamination and to assure future water supply needs are met. To initiate this work, a work plan and milestone will be developed by U. S. Geological Survey by 1 April 1986.
3. The U.S. Geological Survey administrative contact is Mrs. Nancy Williams, FTS 672-4510. Our point of contact is Mr. Bob Alexander, ext. 3034.

R. A. TIEBOUT

Copy to:
BMO
→ NREAD
EnvEngr



PROJECT PROPOSAL

AN APPRAISAL OF THE
GROUND-WATER RESOURCES OF
CAMP LEJEUNE MARINE CORPS BASE
NORTH CAROLINA

U. S. Geological Survey
Raleigh, North Carolina
August 14, 1985

PROJECT REPORT

INVESTIGATION OF THE
WATERSHED RESOURCES OF
THE WATSONVILLE WATERSHED AREA
NORTH CAROLINA

Geological Survey
August 1967

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PROJECT PROPOSAL

TITLE AND LOCATION: Ground-water resources of Camp Lejeune Marine Corps Base, North Carolina.

Camp Lejeune Marine Corps Base, an area of about 170 square miles, is located southeast of the city of Jacksonville in Onslow County, North Carolina. The Base is bounded on the north by N.C. Highway 24, the east by N.C. Highway 172 and Bear Creek, the southeast by the Atlantic Ocean, the southwest by the New River and an irregular line that roughly parallels N.C. Highway 172, and on the west by U.S. Highway 17 (see fig. 1).

PROBLEM: Since Camp Lejeune was first opened in the late 1930's, water supply has been derived from wells that tap freshwater-bearing aquifers (sands and limestone) which occur between land surface and about 400 feet below land surface in the area (see figs. 2 and 3). Clay and silty clay confining beds are interlayered with the aquifer material but are estimated to be thin and discontinuous beneath the Base. Salty water occurs in the deep sand aquifers that underly the area and in the shallow aquifer material adjacent to the Atlantic Ocean and the tidal reaches of the New River and its tributaries.

Over the years, more than 100 wells have been drilled and operated to satisfy increasing demands for water as the Base functions and population grew. At present, ground-water withdrawals are estimated at eight million gallons per day, and Base population is about 100,000.

An increase in the amount of waste generated by Base operations accompanied the growth. As a result, significant amounts of several kinds of wastes containing hazardous and toxic organic compounds have been disposed of or spilled at numerous sites on the base (see fig. 4).

Most of the disposal and spill sites are directly underlain by sand and lack natural or synthetic barriers to contain the wastes and prevent them from moving downward into the ground-water system. Consequently, some of the wastes have infiltrated to the water table and contaminated some of the ground water in the shallow and supply aquifers. Many of the waste-disposal and spill sites are near water-supply wells (see fig. 4), and use of a number of supply wells has been discontinued recently because organic compounds have been detected in the well water.

PROBLEM: continued

Ground-water withdrawals from wells that are near the tidal reaches of the New River and its tributaries may cause salty water in these drainage-ways to move into and through the shallow sand and limestone aquifers toward the pumping wells (see figs. 2 and 3). It is also possible that salty water could be drawn upward from deeper parts of the aquifer system by wells pumping large amounts of ground water from the deep sand aquifers or the lower parts of the limestone aquifer.

Growing water-supply needs coupled with the threat of present and future contamination of existing wells (by disposed wastes or brackish and saline water) has prompted the Marine Corps to request the U.S. Geological Survey to study the geohydrology of the Base and environs and determine ground-water use and management practices that will reduce the chances of further contamination and help assure that future water-supply needs are met.

OBJECTIVES: The objective of this study is to describe the ground-water resources of the Base and to construct an appropriate ground-water flow model that will be used to evaluate alternative ground-water use and management practices that will reduce chances for further contamination and help assure that future water-supply needs are met.

SCOPE: The study area will include the Marine Corps Base and environs. Study elements will include determining (1) the lateral extent, thickness, and hydraulic characteristics of aquifers and confining beds, (2) the potentiometric surfaces of the aquifers, (3) the amounts of ground-water recharge and discharge, (4) the quality of freshwater contained by the aquifers, and (5) the relationship between the freshwater and saltwater in the aquifers. The data collected during these study elements will be used to construct the fine-grid finite-difference ground-water flow model.

Water-level and water-quality data obtained from more than 50 wells that were drilled during the second phase of the Navy Assessment and Control of Installation Pollutants (NACIP) program at the Base will be used in conjunction with data to be collected during the USGS study. The NACIP data will help define the hydrology and any potential and existing water-quality problems. The wells drilled for the NACIP program are designed to test the ground-water quality to a depth no more than ten feet below the water table and are located adjacent to 22 waste-disposal or spill sites at the Base. Analyses of soil, rock, and water samples collected from these wells are being used to confirm whether or not the shallow ground-water and aquifer material have been contaminated.

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The fifth objective is to determine the lateral response of the... and... in these business... and... of the... system by... from the... of the... system.

APPROACH:

1. Water-resources budget--Data on precipitation, evapotranspiration, runoff, water levels and water use will be collected, compiled and analyzed to estimate ground-water recharge and discharge in the area.
2. Geohydrologic framework--The depth to and thickness and lateral extent of the aquifers and confining beds will be determined and mapped from a study of geophysical and lithologic logs made from existing wells and a few new wells that may be constructed for the study.
3. Ground-water movement through the geohydrologic framework--Data from geophysical and lithologic logs will be used in conjunction with aquifer test data from existing and new wells to determine and map the water transmitting and storage capabilities (hydraulic conductivity and storage coefficient, respectively) of the aquifers and confining beds. In addition, water-level data collected from existing and new wells will be used to determine and map the potentiometric surfaces of the aquifers. The water-level data indicate the hydraulic gradient throughout the aquifer systems. The hydraulic gradient, hydraulic conductivity and storage coefficient are needed to determine the direction and rate of ground-water movement in the area.
4. Quality of ground water--Water samples will be collected from existing and new wells and analyzed for concentrations of major ions, including chloride; and organic compounds, heavy metals, and other appropriate chemicals that can be associated with the work or waste disposal at the Base. The water-quality data will be used to identify, quantify, and determine the source of chemical constituents in the fresh ground water and to help determine the position of fresh water-saltwater interface in the Base area.
5. Ground-water flow model--The compiled and analyzed data will be used to construct and calibrate the fine-grid, finite-difference ground-water flow model. The model will be the basic tool with which to analyze the effects of alternative ground-water supply development scenarios for the Base. It will be run on the USGS PRIME computer in the North Carolina District office in Raleigh; however, the model can be transferred to other computer(s) on the Base or elsewhere.

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APPROACH: continued

6. Test drilling--A major part of the study can be implemented with data that is either presently available or can be collected from existing wells. However, some new test drilling will be needed to better define the geohydrologic framework, the factors that control ground-water movement through the framework, and the ground-water quality. It is estimated that about four test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area. Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the saltwater-freshwater interface and its relation to supply-well pumping.

It is assumed that the drilling and sampling of the NACIP program will describe and define the nature and extent of ground-water contamination from hazardous-waste sites on the Base. Therefore, drilling done for the USGS study will be located away from the hazardous-waste sites, as much as possible, to reduce the expense of required and special drilling and safety procedures (like those needed at Cherry Point Marine Corps Air Station).

REPORTS: A report will be written for the USMC describing the results of each completed phase of the investigation (see TIME FRAME for phase descriptions). The completion of the study will result in an interpretative report entitled, "An appraisal of the ground-water resources of Camp Lejeune Marine Corps Base, North Carolina." Additional interpretative reports may be written on various technical aspects of the study. Written progress reports will be prepared and submitted to the USMC quarterly.

RELATION TO LONG-RANGE PLAN: This study relates directly to the North Carolina District's long-range plan (dated May 12, 1980) concerning the quality and availability of ground water in the Coastal Plain.

RELATION TO STATE AND WRD PROGRAMS: The North Carolina Department of Natural Resources and Community Development and the Department of Human Resources are interested and involved in classifying, mapping, and regulating water-use, waste-disposal, and land-use practices throughout the State.

The USGS has a mandate from the U.S. Congress to study and report on the quality and availability of water resources throughout the United States. Ground-water quality is of high national priority for the USGS.

TIME FRAME: The study is tentatively planned for four years and will be divided into three phases. The second phase is extended over a two-year period because of the cost of the work tasks. A brief description of work tasks for each phase follows:

Phase 1 (Fiscal Year 1986[?]) - Collect, compile and analyze all available data on water budget, water use, geohydrologic framework, hydraulic characteristics of aquifers and confining beds, and head and quality of water in aquifers. Prepare a report that describes the available data and new data needs.

Phase 2 (Fiscal Year 1987[?] and 1988[?]) - To fill data needs described in Phase 1 report, design and construct new test wells and new observation wells, and make geohydrologic and chemical tests on new and pre-existing wells. Prepare a report that describes test- and observation-well construction, and the new geohydrologic and chemical data.

Phase 3 (Fiscal Year 1989[?]) - From the analysis of data collected in Phases 1 and 2, construct and calibrate a finite-difference model of ground-water flow through the aquifer and confining-bed materials that underlie the Base area. Determine alternative ground-water use and management practices that will reduce chances for further ground-water contamination and help assure that the future water-supply needs of Camp Lejeune are met effectively and efficiently with the least amount of environmental impact. Recommend a long-term water-level and water-quality monitoring system that will help assure the quality and quantity of the Base water supply. Prepare a report describing the results of Phase 3.

The first phase of the project was to identify the key areas and will be completed by the end of the year. The second phase is expected over a two year period and will be completed by the end of the year. A detailed description of work is provided in the following table.

The project will be managed by the project manager and will be supported by the project team. The project manager will be responsible for the overall management of the project and will be the main point of contact for the sponsor. The project team will be responsible for the day-to-day management of the project and will be supported by the project sponsor.

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MANPOWER:

Project chief:	Hydrologist	GS-12/13	Full time
Project staff:	Hydrologist	GS- 7/ 9	Part time
	Hydrologic technician	GS- 7/ 9	Part time

COSTS: Estimated costs for each phase of the project are summarized below:

Phase 1 (Fiscal Year 1986[?])

Data collection and compilation.	\$ 20,000
Data analysis and synthesis.	30,000
Report preparation	30,000
Fiscal Year 1986(?) Subtotal	<u>\$ 80,000</u>

Phase 2 (Fiscal Year 1987[?] and 1988[?])

Construction and equipment	
Well drilling, construction, sampling and testing (4600 feet at an estimated \$25/foot)	\$115,000
Water sampling equipment	3,000
Geophysical logging (10 days @ \$1000/day).	10,000
Laboratory services (40 samples @ \$500/sample)	20,000
Data collection, analysis, interpretation, and report preparation	80,000
Fiscal Years 1987 and 1988 Subtotal	<u>\$228,000</u>
Fiscal Year 1987.	\$114,000
Fiscal Year 1988.	\$114,000

Phase 3 (Fiscal Year 1989)

Computer time and support personnel. :	\$ 29,000
Data preparation, analysis, interpretation, and report preparation	80,000
Fiscal Year 1989 Subtotal	<u>\$109,000</u>

COST SUMMARY

U. S. Marine Corps Funds

Phase 1 (FY 1986[?]).	\$ 80,000
Phase 2 (FY 1987[?]).	114,000
Phase 2 (FY 1988[?]).	114,000
Phase 3 (FY 1989[?]).	109,000
GRAND TOTAL	<u>\$417,000</u>

Full time
Part time
Part time

Hydrological
Hydrological
Hydrological

Estimated costs for each phase of the project are summarized below:

Phase 1: Initial Year 1987
Phase 2: Initial Year 1988
Phase 3: Initial Year 1989

Phase 4: Initial Year 1990
Phase 5: Initial Year 1991
Phase 6: Initial Year 1992

Phase 7: Initial Year 1993
Phase 8: Initial Year 1994
Phase 9: Initial Year 1995

Phase 10: Initial Year 1996
Phase 11: Initial Year 1997
Phase 12: Initial Year 1998
Phase 13: Initial Year 1999
Phase 14: Initial Year 2000
Phase 15: Initial Year 2001
Phase 16: Initial Year 2002
Phase 17: Initial Year 2003
Phase 18: Initial Year 2004
Phase 19: Initial Year 2005
Phase 20: Initial Year 2006
Phase 21: Initial Year 2007
Phase 22: Initial Year 2008
Phase 23: Initial Year 2009
Phase 24: Initial Year 2010
Phase 25: Initial Year 2011
Phase 26: Initial Year 2012
Phase 27: Initial Year 2013
Phase 28: Initial Year 2014
Phase 29: Initial Year 2015
Phase 30: Initial Year 2016
Phase 31: Initial Year 2017
Phase 32: Initial Year 2018
Phase 33: Initial Year 2019
Phase 34: Initial Year 2020
Phase 35: Initial Year 2021
Phase 36: Initial Year 2022
Phase 37: Initial Year 2023
Phase 38: Initial Year 2024
Phase 39: Initial Year 2025
Phase 40: Initial Year 2026
Phase 41: Initial Year 2027
Phase 42: Initial Year 2028
Phase 43: Initial Year 2029
Phase 44: Initial Year 2030

GRAND TOTAL

BASE MAINTENANCE DIVISION
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA 28542

From: Supervisor, Finance and Property Management Section

To: Cost Accounting

Subj: Job Order for Minor Work or Contract Authorization

1. The following Job Order has been established for accomplishment of minor work/contract authorization as indicated.

a. Labor Class Code 05

b. Service Work Authorization No. _____

c. CAC P1 9171 12002

d. Date Authorized 18 Feb. 1986

e. Job Order No. Charges Amb-23-2095-23100

f. Building Involved _____

g. Description of Work Phase I Ground Water
Study To U.S. Geog. Survey
\$80,000.00

h. Work requested by B. Alex

B. Alex

Copy to:

111

Contract Administration Section

Contract Administration

Contract Administration Section

Contract Administration Section

18000

115

1800

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1800-115-1800

Julian
B. W. B. W.

ASSISTANT CHIEF OF STAFF, FACILITIES
HEADQUARTERS, MARINE CORPS BASE

DATE 4/23/86

TO:

- BASE MAINT O
- PUBLIC WORKS O
- COMM-ELECT O
- DIR., NAT. RESOURCES & ENV. AFFAIRS

- CONSTR. COORD
- DIR, FAMILY HOUSING
- DIR, BACHELOR HOUSING
- BASE FIRE CHIEF

ATTN: U.S.G.S. GROUNDWATER STUDY

1. Attached is forwarded for info/action.

WORK PLAN ATTACHED.

MTG TO KICK OFF STUDY:

2. Please initial, or comment, and return all papers to this office.

Date: TUESDAY, 29 APR.

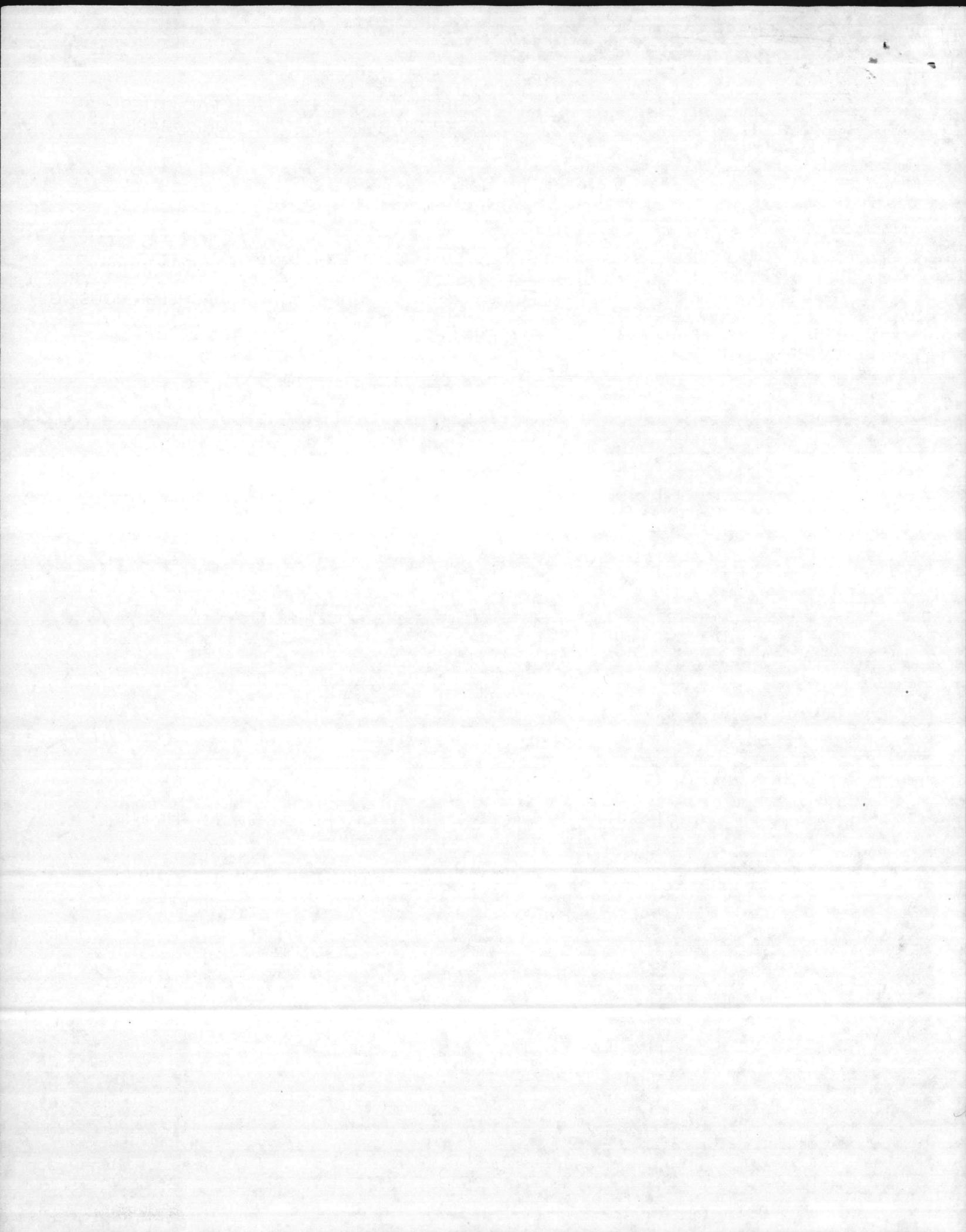
Time: 2:00 p.m.

3. Your file copy.

Loc: FAC Conf. Rm, Bldg I

Call if ?'s.

"LET'S THINK OF A FEW REASONS
WHY IT CAN BE DONE"





United States Department of the Interior

GEOLOGICAL SURVEY

P.O. Box 2857
Raleigh, NC 27602

April 21, 1986

Mr. Robert E. Alexander
Assistant Chief of Staff Facilities
Marine Corps Base
Camp Lejeune, North Carolina 28542

Dear Mr. Alexander:

Enclosed is a proposed work plan for the ground-water study at Camp Lejeune. The work plan covers three phases of work covering four years of study.

As we discussed at our meeting on April 18, 1986 here in Raleigh, we plan a trip to Camp Lejeune April 29-30. Members of our study team including Wanda Meeks, Hydrologic Studies Section Chief, Douglas Harned, Camp Lejeune Project Chief, Charles Daniel, Cherry Point Project Chief, and Steve Howe, Hydrologic Studies Section Technician, will come to meet your staff and tour some of the facilities.

I will contact you by phone Monday, April 28, to discuss scheduling arrangements.

Sincerely,

Douglas A. Harned

Douglas A. Harned
Hydrologist

Enclosure

DAH/kh

WORK PLAN FOR PHASE 1
(April 1, 1986 - April 1, 1987)

Work items to be accomplished during Phase 1 will be based almost entirely on existing data.

WORK TASK I Compile all available ground-water data from USGS, State, and Camp Lejeune files for the area, including water-level, water-quality, water-use, and well log data. Construct a computer data set of this data that will facilitate future statistical analysis.

- a. Compile USGS data sources.
- b. Compile N.C. Department of Natural Resources and Community Development data sources.
- c. Compile Camp Lejeune data resources.
- d. Inventory existing wells, take water-quality samples, and evaluate field parameters including chloride concentration, bromide concentration, pH, temperature, dissolved oxygen, specific conductance.

WORK TASK II Develop preliminary maps and other information products describing the geohydrologic framework beneath the base and adjacent areas in Onslow County.

- a. Evaluate the general lithic character, thickness, extent, and continuity of confining beds and aquifers, from examination of geophysical logs made in existing wells in the study area.
- b. Run new geophysical logs for existing wells where additional data is needed. These logs may include gamma-ray, neutron, bulk density, sonic gravel-time, and caliper logs.

WORK TASK III Map potentiometric surfaces of the water-supply aquifer from water-level measurements made primarily in existing wells in the Air Station area.

- a. Make two sets of water-level measurements in wells and local creeks and streams, one in "wet" and one in the "dry" season.
- b. Establish water-level recorders on selected existing and available wells.
- c. Construct a few shallow wells if needed to prepare a water-table map.

The information from WORK TASKS I, II, and III will be used to make a preliminary assessment of the hydrogeologic framework beneath Camp Lejeune. This assessment will be reviewed in Phase 2a (WORK TASK I) to determine the location and number of test wells to be drilled.

WORK TASK IV Prepare report on the results of the Phase 1 investigations with appropriate illustrations and data tables. The proposed title of the Phase 1 report is "A preliminary geohydrologic framework of the Camp Lejeune Marine Corps Base area, N.C."

WORK PLAN FOR PHASE 2

(Years 2 and 3 (April 1, 1987 - March 30, 1989))

Phase 2 will extend over a two-year period and will be devoted to test drilling and the collection and analysis of additional water quality, hydrogeologic, and aquifer hydraulic-parameter data. The work tasks associated with the drilling, testing, and analysis of new well data will be divided into two subphases, 2a and 2b. Phase 2a will be a drilling phase and Phase 2b will be a testing and data-analysis phase. In order to keep drilling costs at a minimum, an effort is to be made to complete all test drilling scheduled for Phase 2 in the first year (Phase 2a). At the end of Phase 2a, a data report describing the hydrogeology of the new wells will be prepared. The report will include information on geologic formations and aquifer materials penetrated by the test wells, water quality in the wells, and geophysical logs completed by the end of 2a. During the third year of the study, or Phase 2b, geophysical logging of wells will be completed, analysis of the geophysical logs will be completed, editing and refinement of the preliminary hydrologic framework developed during Phase 1 will be completed, and aquifer tests on test wells and existing wells will be conducted to determine hydraulic properties of the aquifers and confining beds. At the end of Phase 2b, a report on the revised hydrogeologic framework will be prepared. This report will include information on the hydraulic and water-quality properties of the aquifers and confining beds and the spatial variability of these properties beneath the base.

PHASE 2a

Year 2 (April 1, 1987 - March 30, 1988)

WORK TASK I Review available geologic, hydrologic, and chemical data and determine exact location and number of test wells to be drilled.

- a. Coordinate drilling and additional data collection with the data compiled during the NACIP investigations at Camp Lejeune in order to share information and minimize expense where possible.
- b. It is estimated that about four test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area. Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the freshwater-saltwater interface and its relation to supply-well pumping.

WORK TASK II Prepare drilling specifications, distribute specifications for bids, and award contract.

WORK TASK III Drill test wells and collect data needed to determine and verify the physical and chemical characteristics of the aquifer and confining-bed materials and fluids that overlie and occur within the deep, limestone water-supply aquifer.

- a. Collect split-spoon samples of aquifer and confining-bed materials at specified depth intervals and analyze selected samples to determine chemical and hydraulic characteristics.
- b. Collect ground-water samples from test wells at specified depths and analyze samples for selected constituents including concentrations of chloride, heavy metals, and organic compounds that can be associated with the work activities at Camp Lejeune.
- c. Make water-level measurements and selected hydraulic tests at specified depth intervals in the test wells to determine the distribution of hydraulic head and hydraulic conductivity.
- d. Make geophysical logs in test wells selecting combinations of gamma-ray, neutron, bulk density, sonic travel-time, resistivity, spontaneous potential, and conductivity surveys best suited to data needs.

WORK TASK IV Prepare report on the results of Phase 2a investigations with appropriate illustrations and data tables. This will be a data report that describes test- and observation-well construction and the new hydrogeologic data from the test wells. The proposed title of the Phase 2a report is "Well logs and hydrologic data from test wells at Camp Lejeune Marine Corps Base, North Carolina." The well logs will include both geophysical and lithologic logs.

PHASE 2b

Year 3 (April 1, 1988 - March 30, 1989)

WORK TASK I Complete drilling, sampling, and hydraulic tests of test wells. (This is first priority work item if drilling and testing of test wells was not completed during Phase 2a or if the drilling of additional wells became necessary.)

WORK TASK II Complete geophysical logging of new and existing wells. Analyze logs.

- a. Analyze the geophysical and lithologic logs to identify depths to aquifer units and confining beds.
- b. Construct fence diagrams to determine the lateral extent of aquifer units and confining beds.

WORK TASK III Conduct aquifer tests on new and existing wells to determine hydraulic properties of aquifer unit(s) and confining beds.

WORK TASK IV Based on new findings, refine and edit the preliminary assessment of the hydrogeologic framework that was developed during Phase 1.

WORK TASK V Prepare a report that describes the refined hydrogeologic framework. The proposed title of the phase 2b report is "Hydrogeologic framework beneath Camp Lejeune Marine Corps Base, North Carolina."

WORK PLAN FOR PHASE 3

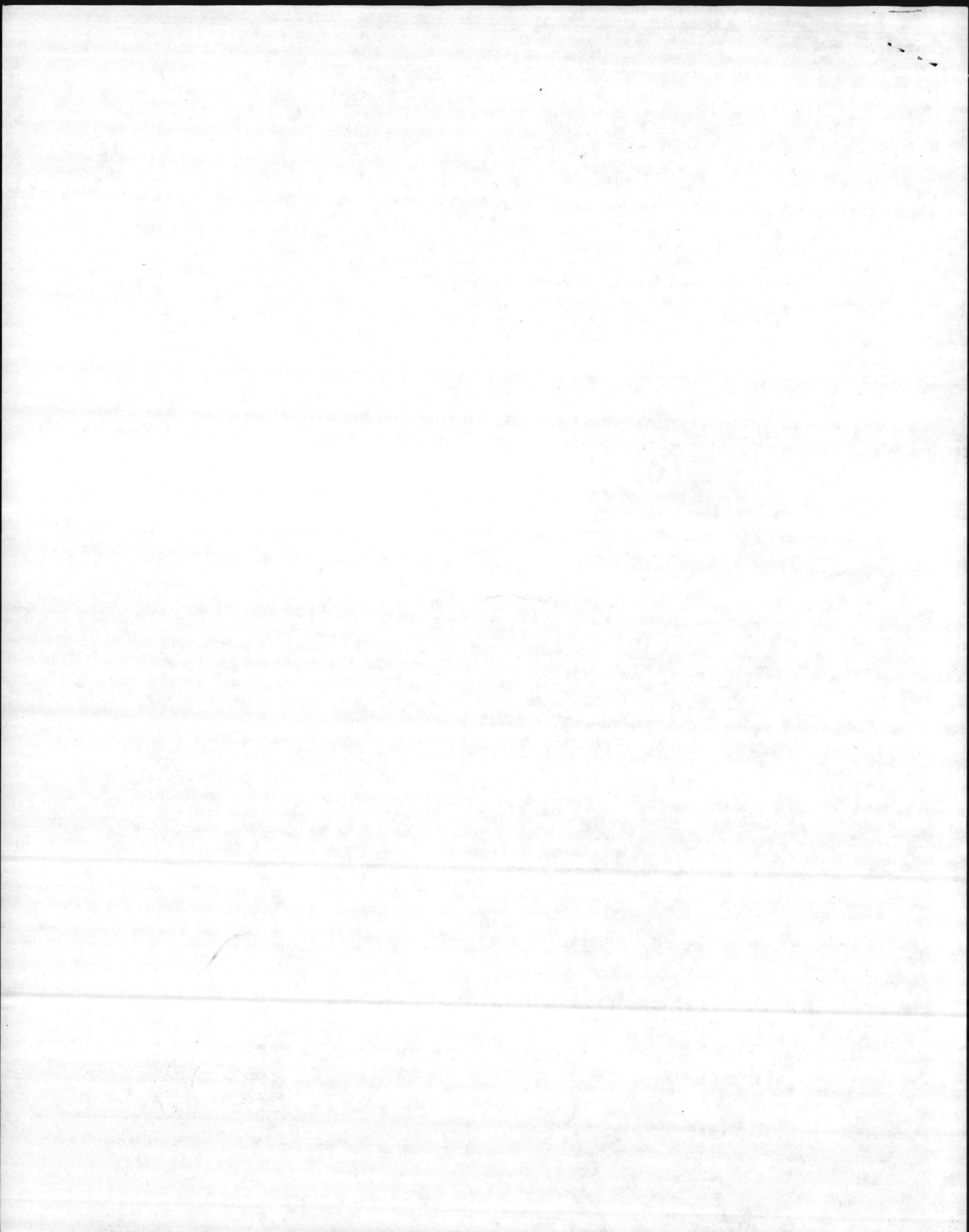
Year 4 (April 1, 1989 - March 30, 1990)

WORK TASK I Construct a finite-difference ground-water flow model of the hydrogeologic system in and around Camp Lejeune based on the data and interpretations that resulted from investigations during Phases 1 and 2.

- a. Determine grid system for area and discretize appropriate maps of aquifer and confining-bed characteristics (such as structure tops, thicknesses, hydraulic conductivity, potentiometric surfaces, etc.).
- b. Determine boundary conditions.
- c. Develop a steady-state digital model for unstressed (pre-pumping) conditions in the area.
- d. Evaluate different ground-water pumpage and development schemes to determine which alternatives will reduce the chances for contamination of the water-supply aquifer (optimization analysis).

The ground-water flow model will be a management aid that can be used (1) to guide site selection for new wells through prediction of water-level drawdowns that will occur in response to planned pumping rates at potential well sites, and (2) to evaluate water-level drawdowns at existing production wells through prediction of drawdowns that would occur in response to alternative pumping schedules. The potential benefits to be gained from model studies are less well interference, lower pumping costs, and reduced chance for contamination of the water supply.

WORK TASK II Prepare report on the results of Phase 3 investigations with appropriate illustrations and data tables. The proposed title of the Phase 3 report is "Ground-water supply and potential for contamination--Camp Lejeune Marine Corps Base, North Carolina."



WORK PLAN FOR PHASE 1
(April 1, 1986 - April 1, 1987)

Work items to be accomplished during Phase 1 will be based almost entirely on existing data.

WORK TASK I Compile all available ground-water data from USGS, State, and Camp Lejeune files for the area, including water-level, water-quality, water-use, and well log data. Construct a computer data set of this data that will facilitate future statistical analysis.

- a. Compile USGS data sources.
- b. Compile N.C. Department of Natural Resources and Community Development data sources.
- c. Compile Camp Lejeune data resources.
- d. Inventory existing wells, take water-quality samples, and evaluate field parameters including chloride concentration, bromide concentration, pH, temperature, dissolved oxygen, specific conductance.

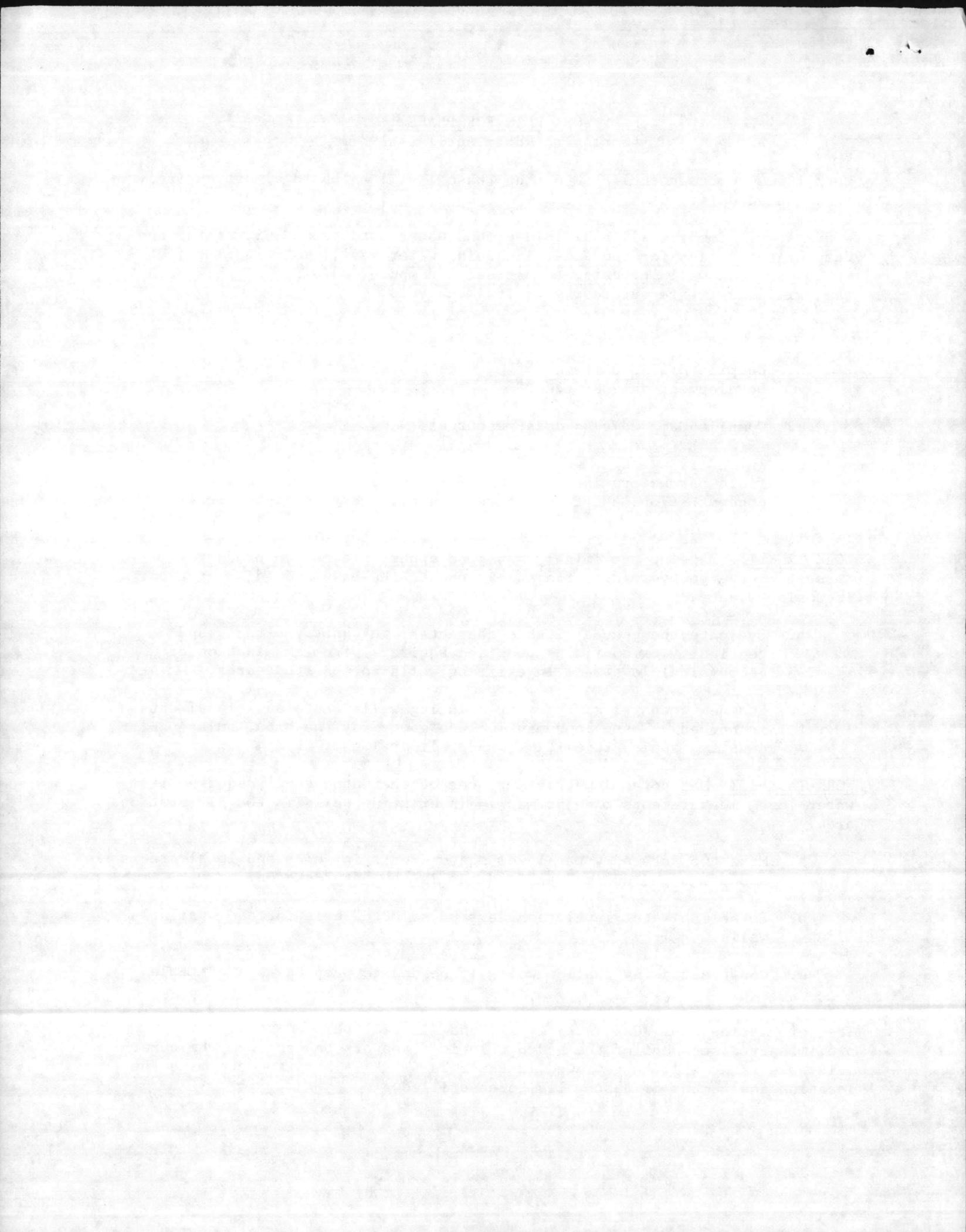
WORK TASK II Develop preliminary maps and other information products describing the geohydrologic framework beneath the base and adjacent areas in Onslow County.

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WORK TASK III Map potentiometric surfaces of the water-supply aquifer from water-level measurements made primarily in existing wells in the Air Station area.

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The information from WORK TASKS I, II, and III will be used to make a preliminary assessment of the hydrogeologic framework beneath Camp Lejeune. This assessment will be reviewed in Phase 2a (WORK TASK I) to determine the location and number of test wells to be drilled.



WORK TASK IV Prepare report on the results of the Phase 1 investigations with appropriate illustrations and data tables. The proposed title of the Phase 1 report is "A preliminary geohydrologic framework of the Camp Lejeune Marine Corps Base area, N.C."

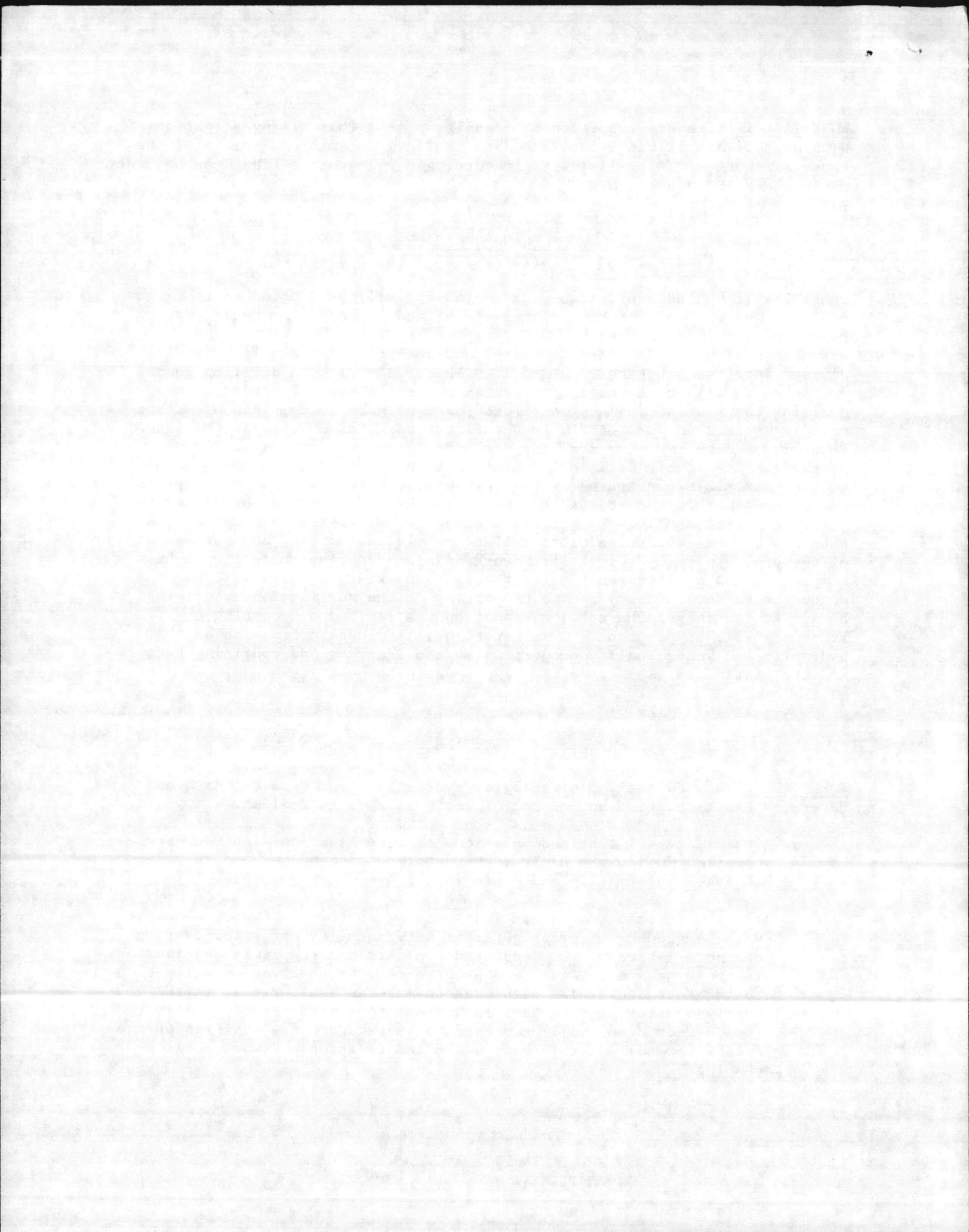
WORK PLAN FOR PHASE 2
(Years 2 and 3 (April 1, 1987 - March 30, 1989))

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PHASE 2a
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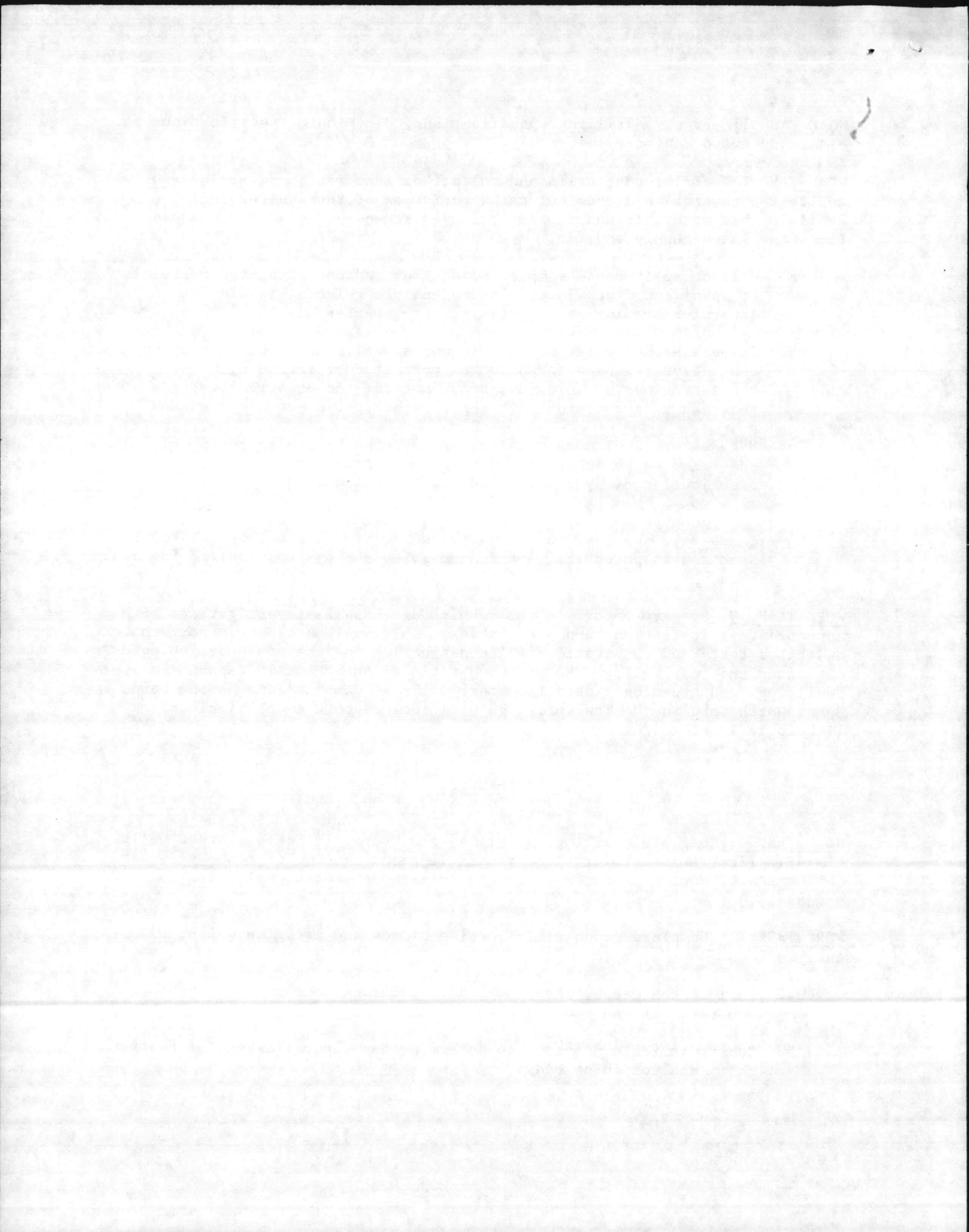
PHASE 2b

Year 3 (April 1, 1988 - March 30, 1989)

WORK TASK I Complete drilling, sampling, and hydraulic tests of test wells. (This is first priority work item if drilling and testing of test wells was not completed during Phase 2a or if the drilling of additional wells became necessary.)

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- a. Analyze the geophysical and lithologic logs to identify depths to aquifer units and confining beds.
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WORK TASK IV Based on new findings, refine and edit the preliminary assessment of the hydrogeologic framework that was developed during Phase 1.

WORK TASK V Prepare a report that describes the refined hydrogeologic framework. The proposed title of the phase 2b report is "Hydrogeologic framework beneath Camp Lejeune Marine Corps Base, North Carolina."

WORK PLAN FOR PHASE 3

Year 4 (April 1, 1989 - March 30, 1990)

WORK TASK I Construct a finite-difference ground-water flow model of the hydrogeologic system in and around Camp Lejeune based on the data and interpretations that resulted from investigations during Phases 1 and 2.

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WORK TASK II Prepare report on the results of Phase 3 investigations with appropriate illustrations and data tables. The proposed title of the Phase 3 report is "Ground-water supply and potential for contamination--Camp Lejeune Marine Corps Base, North Carolina."



ASSISTANT CHIEF OF STAFF, FACILITIES
HEADQUARTERS, MARINE CORPS BASE

DATE 7/23

TO:

BASE MAINT O

DIR, FAMILY HOUSING

PUBLIC WORKS O

DIR, BACHELOR HOUSING

COMM-ELECT O

BASE FIRE CHIEF

DIR., NAT. RESOURCES & ENV. AFFAIRS

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From DDS

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*training courses would be directed toward
newcomers like myself to this field.*

Tom Barber 8/5/86

3

bob

Your file copy

"LET'S THINK OF A FEW REASONS
WHY IT CAN BE DONE"

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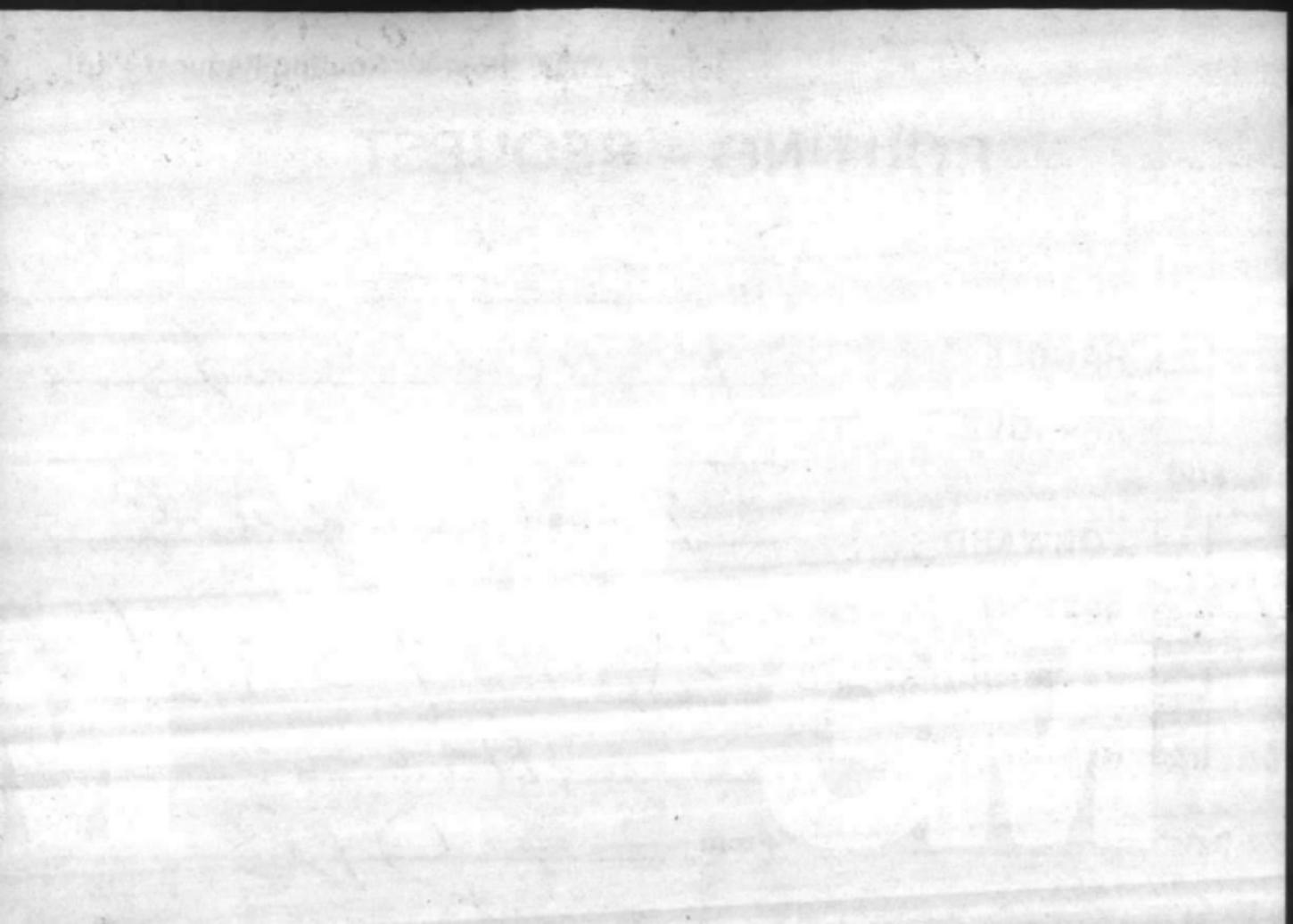
And advise

of any significant
info.

Date _____

From

DDS



Reference page 52, No 15.

Since I am both involved with and interested in groundwater / ground water pollution, I am curious to find out if these training courses would be directed toward newcomers like myself to this field.

Tom Barber 8/5/86

ASSISTANT CHIEF OF STAFF, FACILITIES
HEADQUARTERS, MARINE CORPS BASE

DATE 7/23

TO:

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ATTN: USGS Update

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routed.*

~~2. Please initial, or comment, and return all papers to this office.~~

Thanks,

Bob

~~3. Your file copy.~~

"LET'S THINK OF A FEW REASONS
WHY IT CAN BE DONE"

3



United States Department of the Interior

GEOLOGICAL SURVEY

Post Office Box 2857
Raleigh, North Carolina 27602

A 7/23

July 18, 1986

Mr. Robert Alexander
Environmental Engineer
Marine Corps Base
Assistant Chief of Staff Facilities
Camp Lejeune, North Carolina 28542

Dear Mr. Alexander:

We are pleased to send you the enclosed copy of the progress report on "Water-Resources Investigations in North Carolina--April-June 1986." This document describes program status, plans, and changes related to current operations of the U.S. Geological Survey in North Carolina. This report is prepared quarterly and provided to State, local, and Federal agencies with whom we have cooperative programs.

This is an unofficial document of the Geological Survey and is intended only for the internal use of the Survey and cooperating agencies. The report should not be duplicated or released without expressed written consent of the Geological Survey and cooperating agencies.

This copy is sent to you because of your interest in our cooperative programs. If you have questions or need further information, please let me know.

Very truly yours,

Handwritten signature: James F. Turner for
James F. Turner
District Chief

Enclosure

JFT/rjd



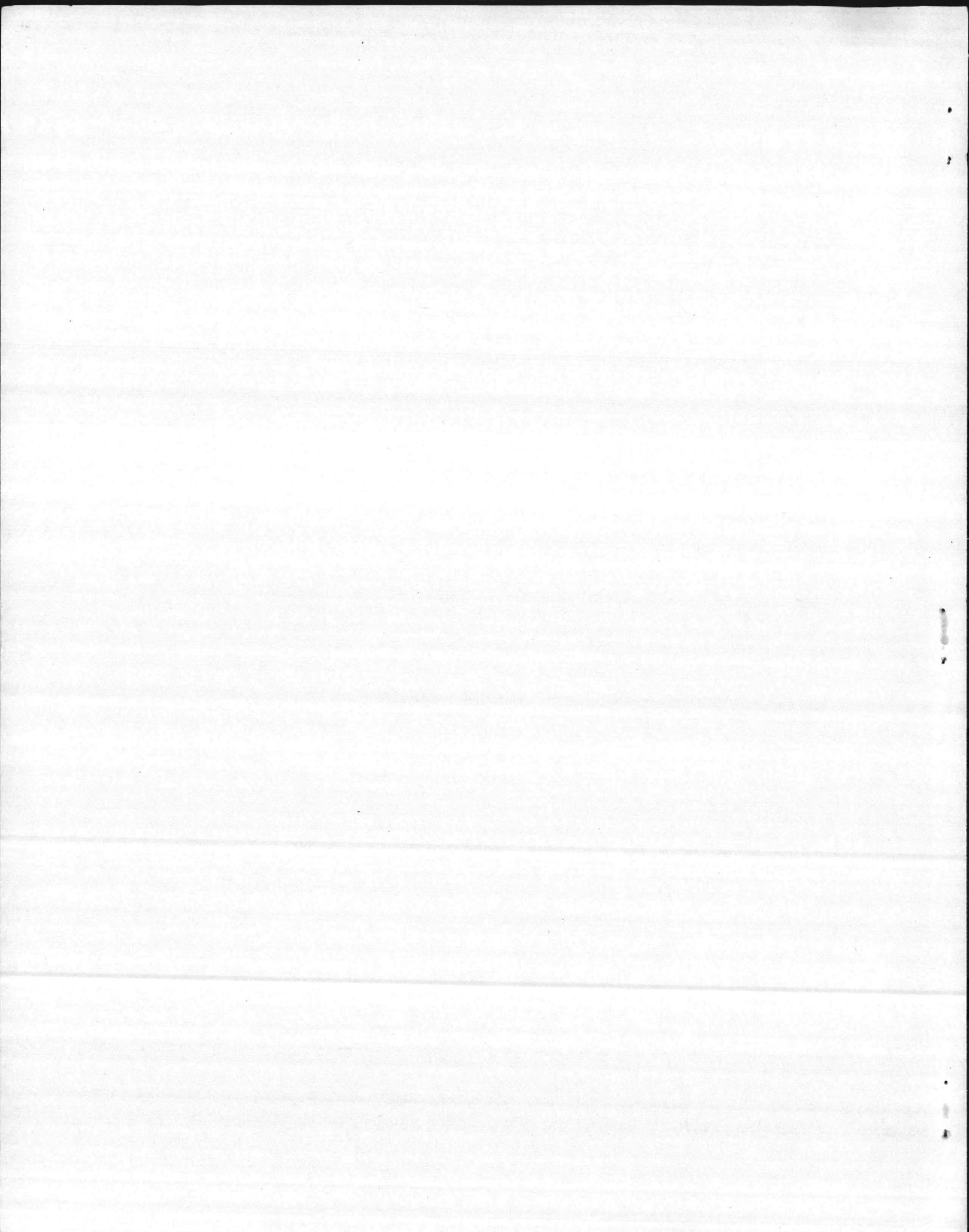
WATER - RESOURCES INVESTIGATIONS IN NORTH CAROLINA



**U.S. GEOLOGICAL SURVEY
QUARTERLY PROGRESS REPORT
APRIL - JULY 1986**

**JULY 1986
RALEIGH, NORTH CAROLINA**





WATER - RESOURCES INVESTIGATIONS IN NORTH CAROLINA

U.S. GEOLOGICAL SURVEY QUARTERLY PROGRESS REPORT

Cooperating Agencies

North Carolina Department of Natural Resources
and Community Development
North Carolina Department of Human Resources
North Carolina Department of Transportation

Greene County
Guilford County
Jones County
Mecklenburg County
Onslow County
City of Charlotte
City of Durham
City of Greensboro
City of Kinston
City of New Bern
City of Raleigh
City of Rocky Mount
City of Jacksonville
Greenville Utilities Commission
Town of Ayden
Town of Farmville
Town of LaGrange
Town of Pinetops
Town of Snow Hill
Town of Stantonsburg

Environmental Protection Agency
Federal Emergency Management Agency
Federal Energy Regulatory Commission
Tennessee Valley Authority
U. S. Army Corps of Engineers
U. S. Soil Conservation Service

Raleigh, North Carolina

PREFACE

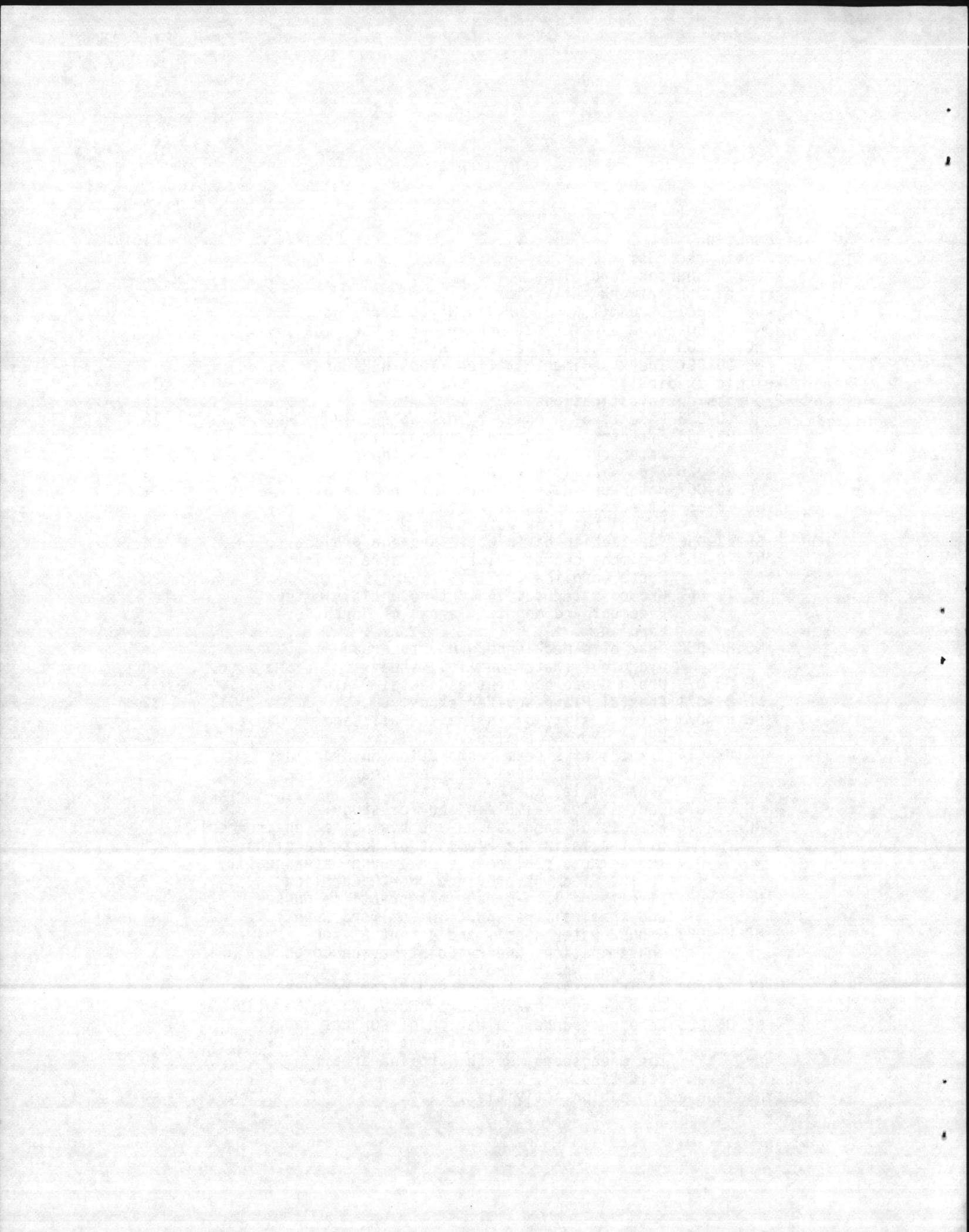
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For additional information write to:

District Chief
U. S. Geological Survey
Post Office Box 2857
Raleigh, North Carolina 27602

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NC 84-077 The effects of land use on ground-water quality in the Piedmont province, North Carolina	39
NC 85-081 Effects of land-management practices on sediment and chemical transport in Guilford County.	41
NC 86-083 Ground-water supply and potential for contamination, Cherry Point Marine Corps Air Station, North Carolina.	43
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INTRODUCTION

The U. S. Geological Survey conducts a variety of water-resources investigations in North Carolina in cooperation with the North Carolina Department of Natural Resources and Community Development (NRCD) and other State, local, and Federal agencies. These activities include hydrologic records and hydrologic studies. This document summarizes progress on all water-resources investigations and activities conducted by the U. S. Geological Survey in North Carolina during the period April through June 1986. Program summaries, such as this, are prepared each quarter and provided to cooperating agencies to keep them informed of current status of on-going investigations.

HYDROLOGIC RECORDS

Hydrologic records activities include the routine collection and processing of data from streamflow, ground-water, water-quality, and sediment stations located across the State. Data for these stations are processed, analyzed, and stored in the National WATSTORE data base of the Survey located at Reston, Virginia, and are available on request. Data for selected stations are published as part of an annual report entitled, "Water-Resources Data for North Carolina," and in other formal publications of the Survey.

This section of the report summarizes water-resources conditions across North Carolina, progress on hydrologic records investigations and activities, and the number of gaging stations by source of funding.

Water-Resources Conditions

Streamflow conditions across the State have been below normal for the past six months. Flow of some streams were at or below the lowest 25 percentile of record. Record-low monthly and daily flows were observed at the following index stations:

	<u>April</u>	<u>May</u>	<u>June</u>
French Broad River at Asheville (Blue Ridge)	M, D	D	--
South Yadkin River near Mocksville (Piedmont)	M, D	M	M, D
Contentnea Creek at Hookerton (Coastal Plain)	--	M, D	M, D

D = record-low daily flow.
M = record-low monthly flow.

Ground-water levels in unconfined aquifers ranged from approximately 1 to 3 feet below average at the end of the the quarter. In general, ground-water levels were above average at the beginning of the quarter but are now beginning to show the effects of the prolonged period of deficient rainfall.

Although very low for this time of the year, streamflow has generally been adequate to meet public water supply needs. Water use in several cities has set record highs. Water-use restrictions have been necessary in some areas because water-use demands exceeded water treatment plant capacities and distribution system limitations.

Drought conditions may worsen considerably in July, August, and September without normal rainfall. If rainfall during these months is deficient, serious water shortages are likely.

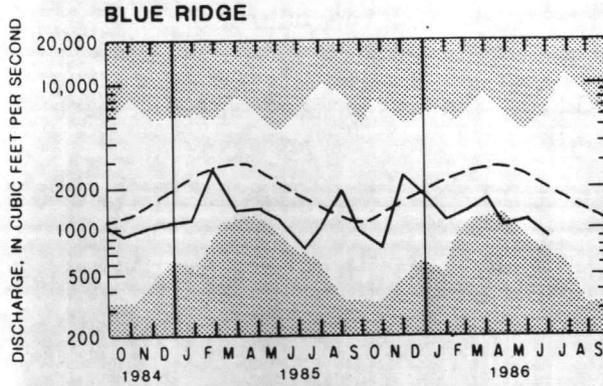
SURFACE WATER

MONTHLY MEAN DISCHARGE IN KEY STREAMS

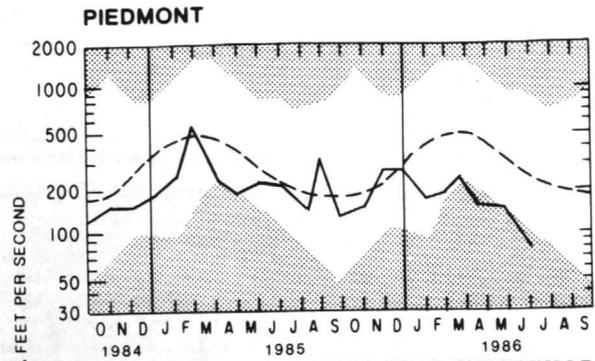
UNSHADED AREA INDICATES RANGE BETWEEN HIGHEST AND LOWEST RECORD FOR THE MONTH

DASHED LINE INDICATES MEDIAN OF MONTHLY STREAMFLOW IN PREVIOUS YEARS

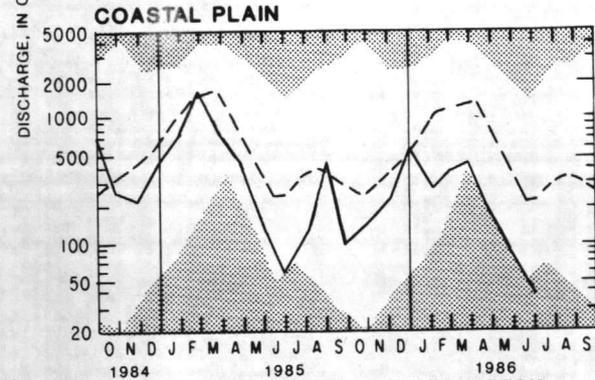
HEAVY LINE INDICATES MEAN FOR CURRENT PERIOD



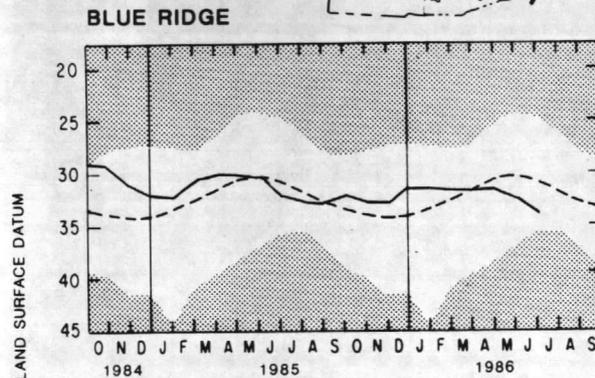
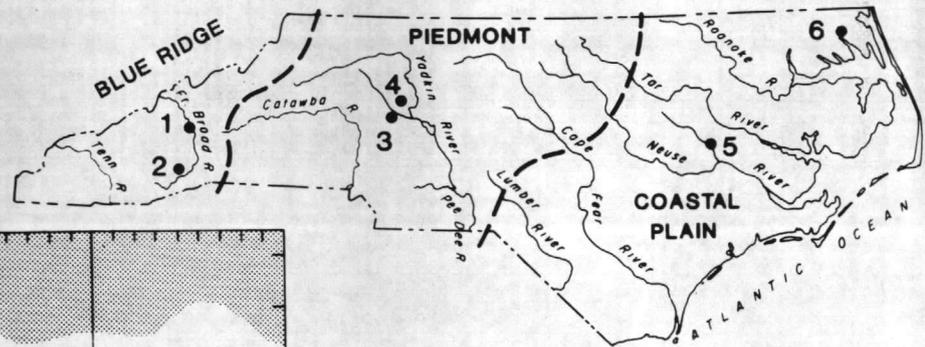
1 FRENCH BROAD RIVER AT ASHEVILLE
Records begin 1895



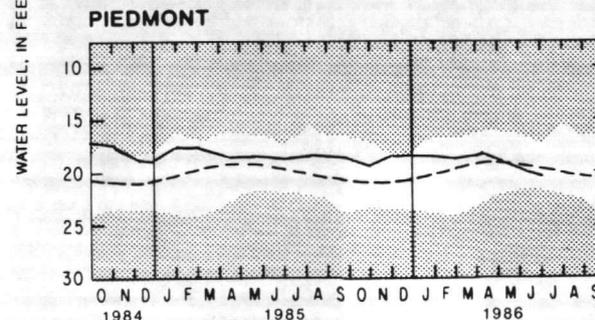
3 SOUTH YADKIN RIVER NEAR MOCKSVILLE
Records begin 1938



5 CONTENTNEA CREEK AT HOOKERTON
Records begin 1928



2 BLANTYRE WELL - Transylvania County,
in granite, 58 ft. deep. Records begin 1932



4 MOCKSVILLE WELL - Davie County,
in granite, 31 ft. deep. Records begin 1931

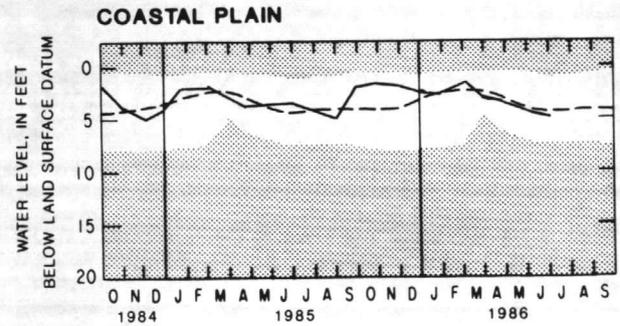
GROUND WATER

MONTH-END GROUND-WATER LEVELS IN KEY WELLS

UNSHADED AREA INDICATES RANGE BETWEEN HIGHEST AND LOWEST RECORD FOR MONTH-END LEVELS

DASHED LINE INDICATES AVERAGE OF MONTH-END LEVELS IN PREVIOUS YEARS

HEAVY LINE INDICATES MONTH-END LEVELS FOR CURRENT PERIOD



6 ELIZABETH CITY WELL - Pasquotank County,
in sand, 10 ft. deep. Records begin 1936

Progress on Network Activities

The 1986 water-resource data-collection program is summarized in the table on page 5. The type and number of stations and funding source are provided. Low-flow partial-record stations that had previously been suspended were reactivated during the quarter.

Summary statements describing progress on activities involving streamflow, ground-water, water-quality, and sediment networks are provided in the remainder of this section.

SUMMARY OF WATER RESOURCES DATA COLLECTION PROGRAM FOR NORTH CAROLINA, 1986
Numbers of Stations by Funding Source

	Federal Noncooperative				Cooperative (USGS Matched)										Partial Support			Changes During Qtr.		
	USGS	TVA	COE	USDA SCS	State			Municipal					County	Corporate thru NRCDC	State (Matched)	Federal Agencies (Unmatched)	Licensees of FERC			
					NRCDC	DHR	DOT	Charlotte	Durham	Greensboro	Rocky Mount	Raleigh						Asheville	Guilford	Add
SURFACE WATER CONTINUOUS RECORD STATIONS	4	3	25	2	65	2	5	8	3	2	2	4	1	4	16	24	30	6	5**	
SURFACE WATER PARTIAL RECORD STATIONS			4	2	105	1			1	7					7					
GROUND WATER OBSERVATION WELLS	2			8	44	47								18	1					
WATER QUALITY STATIONS	16		11	4	8	5		53*					1	4					4**	

TVA - Tennessee Valley Authority
 COE - U. S. Army Corps of Engineers
 SCS - U. S. Soil Conservation Service
 NRCDC - North Carolina Department of Natural Resources and Community Development
 DHR - North Carolina Department of Human Resources
 DOT - North Carolina Department of Transportation
 FERC - Federal Energy Regulatory Commission
 USGS - U. S. Geological Survey

** 0214042720 North Harper Creek near Kawana
 ** 0213875850 High Shoals Creek near Dysartsville
 ** 0209555450 Buffalo Creek at High Rock Road near Osceola
 ** 0206900000 Dan River at Pine Hall
 ** 0345092550 Ross Creek near Asheville

* 37 Ground-water stations, 16 Surface-water stations

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INVESTIGATION NC 00-001: Streamflow Network in North Carolina

PERIOD OF INVESTIGATION: 1927 - continuing

INVESTIGATION CHIEF: N. M. Jackson, Jr.

COOPERATOR: North Carolina Department of Natural Resources
and Community Development (NRCD), U. S. Army
Corps of Engineers, and others

OBJECTIVE: The overall objective of this investigation is to collect, analyze, and publish a statewide inventory of streamflow records for North Carolina. The data are required in the evaluation, planning, development, and management of surface-water resources of the State. Specific uses of the data include: (1) assessment of water resources; (2) operation of reservoirs or industries; (3) forecasting; (4) disposal of wastes and pollution control; (5) discharge data to accompany water-quality measurements; (6) compact and legal requirements; and (7) research of special studies. Data for analytical studies define statistical properties and trends in the occurrence of water in streams, lakes, estuaries, etc. for use in the planning and design.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Processing of 1985 water-year records and preparation of the 1985 water-resources data report is complete. Report is due back from the printer June 25. Two stations in the Yadkin River basin were instrumented for rainfall. This information will be transmitted by the data collection platforms in the station. Routine annual maintenance, including levels, was begun. Field reconnaissance for a new gage in Scotland County to replace Creeping Swamp gage near Vanceboro was begun. Processing of 1986 water-year records was brought up to date.

Gaging stations were installed for projects as follows:

1. Water-quality network - two gaging stations in the Blue Ridge;
2. Asheville urban study - one gaging station in Asheville; and
3. Greensboro water-quality study - one continuous and one partial record station.

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PLANS FOR NEXT QUARTER:

1. Design and construct, if flows permit, gage on Roanoke River at Oak City.
2. Construct and install new gaging station on Flat Swamp near Robersonville in Martin County.
3. Rebuild Neuse River at Falls gage.
4. Discontinue South River near Parkersburg and add a new station as a replacement in the coop program. This is a result of the meeting with NRCD discussing limited re-design of the gaging station network in the USGG-NRCD cooperative program.
5. New station to be built in Scotland County area as a replacement for discontinued Creeping Swamp gage near Vanceboro.
6. Complete annual maintenance.
7. Rebuild 02091500 Contentnea Creek at Hookerton gage due to safety concerns. Present gage and cable will be torn down.

REPORT STATUS: Records collected as part of this program are published in the annual data report, "Water-Resources Data for North Carolina, Water Year 19__." The 1985 annual data report is being printed.

PUBLISHED REPORTS:

- U. S. Geological Survey, 1984, Water-Resources Data for North Carolina, Water Year 1984: U. S. Geological Survey Water-Data Report NC-84-1. Similar data reports are available for previous water years.
- Mason, R. R., and Jackson, N. M. Jr., Cost-effectiveness of the stream-gaging program in North Carolina: U. S. Geological Survey Water-Resources Investigations Report 85-4036.

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PROJECT HIGHLIGHTS:

- A. Project stage: Ongoing.
- B. Cooperator contacts: Meetings were held with NRCD and other State, local, and Federal agencies to discuss the FY 87 program. Currently, only minor reductions in funding are anticipated.
- C. Changes affecting project elements: One station was activated.
- D. Problems associated with project: None.
- E. Hydrologic data released: Numerous requests for information were answered. The requests included average flows, 7-day, 10-year minimum flows, and statistical summaries of long-term flow data. Approximately 202 requests for low-flow statistics were answered for the Division of Environmental Management. Requests for 35 floodprone area maps were filled.

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INVESTIGATION NC 00-002: Ground-Water Network in North Carolina

PERIOD OF INVESTIGATION: 1943 - continuing

INVESTIGATION CHIEF: R. W. Coble

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD) and others

OBJECTIVE: The objective of this investigation is to collect, analyze, and publish a statewide inventory of water-level records for North Carolina. These data are needed in the evaluation, planning, development, and management of ground-water resources in North Carolina. These records provide a long-term data base for evaluating general response of the hydrologic system to natural climatic variations and induced stresses; known and potential problems can be defined early enough to allow proper planning and management. The data base also includes short-term records acquired in areal studies of: (1) assessment of the ground-water resources; (2) prediction of future conditions; and, (3) resource management.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Processing of 1986 water-year records for 45 observation wells is current. Selection of observation wells for the combined USGS and NRCD observation-well network in the Coastal Plain was begun. Ten climatic-effects wells and (or) sites and wells in the areal- and local-effects networks for the upper and lower Tertiary aquifers and upper, middle, and lower Cretaceous aquifers which are to be equipped with digital recorders have been chosen.

PLANS FOR NEXT QUARTER: Continue collection and processing of records for 1986 water year. Updating of the ground-water site inventory (GWSI) files are to begin following the completion of the downloading of data onto the District's Prime computer.

Efforts to combine the USGS and NRCD statewide water-level monitoring networks will continue. Emphasis will be on constructing shallow wells for the climatic-effects network at Coastal Plain sites and preparing for a mass measurement of all Coastal Plain wells scheduled for late summer or early fall. Aquifer codes for the USGS Ground-Water Site Inventory system will be revised to match aquifer designations of the Regional Aquifer System Analysis, the combined USGS/NRCD network, and recently completed hydrogeologic-unit identification in the Piedmont and Blue Ridge provinces.

REPORT STATUS: Records collected as part of this program are published in the annual data report, "Water Resources Data for North Carolina." The 1986 annual data report is in process.

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PUBLISHED REPORTS:

- U. S. Geological Survey, 1984, Water-Resources Data for North Carolina, Water Year 1984: U. S. Geological Survey Water-Data Report NC-84-1. Similar data reports are available for previous years.

PROJECT HIGHLIGHTS:

- A. Project stage: Ongoing.
- B. Cooperator contacts: Biweekly meetings between USGS and NRCDC were held in order to combine the observation-well networks.
- C. Changes affecting project elements: Funding for this fiscal year is greater than funding in the past; this provides opportunities to improve the ground-water program.
- D. Problems associated with project: None.
- E. Hydrologic data released: Provided data in response to routine requests. All field and laboratory data are available through WATSTORE system. Water-level data from index wells were released to the press during inquiries about drought conditions.

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INVESTIGATION NC 00-003: Water-Quality Network in North Carolina

PERIOD OF INVESTIGATION: 1943 - continuing

INVESTIGATION CHIEF: C. E. Simmons

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD) and others

OBJECTIVE: The objective of this investigation is to collect, analyze, and publish a statewide inventory of chemical-quality records on streams in North Carolina. The primary emphasis of this investigation is to evaluate development-induced and pristine stream-quality conditions. Variability and long-term trends in levels of selected chemical constituents, and the extent to which these constituent levels are present and have increased in the aquatic environment, are monitored and evaluated. Federal NASQAN and Benchmark and NRCD-supported baseline (pristine) stations comprise the data-collection network of this project.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The collection and processing of samples were performed on a current basis.

Construction of the new pristine sampling network, in cooperation with NRCD, was completed. Pristine sites comprising the network are listed below:

03450000	Beetree Creek near Swannanoa (Buncombe Co.)
02123567	Dutchmans Creek near Uwharrie (Montgomery Co.)
0209782150	New Hope R. Trib. near Farrington (Chatham Co.)
0210108450	Suck Creek Trib. near Zion Grove (Moore Co.)
0209257120	West Prong Brice Crk. near Riverdale (Craven Co.)
0205356401	Chinkapin Crk. Trib. nr. Harrellsville (Hertford)
0210797940	Limestone Crk. at NC 24 Hadley (Duplin Co.)
0213024165	Shaw Crk. near White Store (Anson Co.)
0214042720	North Harper Creek near Kawana (Avery Co.)
0213875850	High Shoals Creek near Dysortville (McDowell Co.)

PLANS FOR NEXT QUARTER: Continue sampling and collection of basic data.

REPORT STATUS: All records collected as part of this program are published in the annual data report, "Water-Resources Data for North Carolina." The 1985 data report is in process.

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PUBLISHED REPORTS: Interpretive reports based on data collected as part of this investigation are as follows:

- Crawford, J. K., 1984, Water-quality characteristics for selected sites on the Cape Fear River, North Carolina, 1955-80--variability, loads, and trends of selected constituents: U. S. Geological Survey Water-Supply Paper 2185-F (in press). (Previously published as U. S. Geological Survey Open-File Report 83-526.)
- Daniel, C. C., III, Wilder, H. B., and Weiner, M. S., 1982, Water quality of the French Broad River, North Carolina--an analysis of data collected at Marshall, 1958-77: U. S. Geological Survey Water-Supply Paper 2185-C, 28 p. (Previously published as U. S. Geological Survey Water Resources Investigations Report 79-87.)
- Harned, D. A., 1982, Water quality of the Neuse River, North Carolina--variability, pollution loads, and long-term trends: U. S. Geological Survey Water-Supply Paper 2185-D, 44 p. (Previously published as U. S. Geological Survey Water Resources Investigations Report 80-36.)
- Harned, Douglas, and Meyer, Dann, 1983, Water quality of the Yadkin-Pee Dee River system, North Carolina--variability, pollution loads, and long-term trends: U. S. Geological Survey Water-Supply Paper 2185-E, 71 p. (Previously published as U. S. Geological Survey Open-File Report 81-643.)
- Simmons, C. E. and Heath, R. C., 1979, Water-Quality Characteristics of Streams in Forested and Rural Areas of North Carolina: U. S. Geological Survey Water-Supply Paper 2185-B, 33 p. (Previously published as U. S. Geological Survey Water Resources Investigations Report 79-108.)
- U. S. Geological Survey, 1984, Water Resources Data for North Carolina, Water Year 1984: U. S. Geological Survey Water-Data Report NC 84-1. (Similar data reports are available for previous years.)
- Wilder, H. B., and Simmons, C. E., 1978, Program for Evaluating Stream Quality in North Carolina: U. S. Geological Survey Water-Supply Paper 2185-A, 15 p. (Previously published as U. S. Geological Survey Circular 764.)

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PROJECT HIGHLIGHTS:

- A. Project stage: Ongoing
- B. Cooperator contacts: Several phone discussions were held with NRCO during the quarter to discuss progress.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: Data related to this project are on file in District Office and in WATSTORE.

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INVESTIGATION NC 00-004: Index Sediment Station-Yadkin River

PERIOD OF INVESTIGATION: 1943 - continuing

INVESTIGATION CHIEF: C. E. Simmons

COOPERATOR: Federal

OBJECTIVE: The objective of this investigation is to provide a national sediment data base for use by local, State, and Federal agencies in broad planning and action programs and to provide data for management of interstate waters. Sampling station is located on the Yadkin River at Yadkin College.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The collection of daily water samples was continued. Suspended-sediment concentrations were determined for approximately 90 routine samples. Laboratory analyses of concentrations are current.

PLANS FOR NEXT QUARTER: Sampling and laboratory analyses will continue.

REPORT STATUS: Suspended-sediment data collected as part of this project will be published in the annual report, "Water Resources Data for North Carolina." The 1985 data report is in process. The data collected as part of this project are used in conjunction with other projects and preparation of interpretive reports.

PUBLISHED REPORTS:

U. S. Geological Survey, 1984, Water-Resources Data for North Carolina, Water Year 1984: U. S. Geological Survey Water-Data Report NC-84-1. Similar data reports are available for previous water years.

PROJECT HIGHLIGHTS:

- A. Project stage: Ongoing Federal Index Station.
- B. Cooperator contacts: None
- C. Changes affecting project elements: None
- D. Problems associated with project: None
- E. Hydrologic data released: None

HYDROLOGIC STUDIES

Hydrologic investigations conducted by the Geological Survey in North Carolina include topics, such as: water use, impacts of channelization, non-point source pollution, sediment characteristics, water-quality characteristics of streams, sediment effects on stream biology, effects of land use on ground-water quality, ground-water development potential in the Piedmont and Blue Ridge (mountain) provinces, urban hydrology, and ground water in the Coastal Plain aquifer system. Results of these studies are published in a variety of scientific and technical reports, abstracts, and papers. Reports are provided to local cooperating agencies and various libraries and repositories.

Progress on Investigations

Summary statements describing progress on each investigation are provided in this section.

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INVESTIGATION NC 00-003: (Formerly NC 81-072) Effects of Highway Runoff on Receiving Waters

PERIOD OF INVESTIGATION: 1983-84

INVESTIGATION CHIEF: Douglas A. Harned

COOPERATOR: Federal

OBJECTIVE: The objective of this investigation is to evaluate the effects of runoff from a major highway on stream quality of a small basin in the Piedmont province of North Carolina. The hydrologic data were collected under project NC 81-072.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The report has been submitted for approval for publication.

PLANS FOR NEXT QUARTER: Publish the final report.

REPORT STATUS: The following report has been revised according to suggestions from the colleague reviewers and submitted for regional approval:

Harned, D. A., 1985, Impact of highway runoff on stream quality in the Sevenmile Creek basin near Efland, North Carolina: U. S. Geological Survey Water-Resources Investigations Report (in process).

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: Review of the report by the S.E. Region office.
- B. Cooperator contacts: Federal program - no local cooperators.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 83-005: Effects of Atmospheric Deposition on
Water Quality of North Carolina
Streams

PERIOD OF INVESTIGATION: 1983-92

INVESTIGATION CHIEF: J. Kent Crawford

COOPERATOR: Federal Research Program--USGS

OBJECTIVE: To determine the extent and severity of acid deposition in the Sandhills area of southeastern North Carolina and the impact of acid deposition on the water quality of area streams.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Routine monitoring at the calibrated watershed site and at the atmospheric deposition site continued during the quarter. Erosion problems on the road at the Jordan Creek site were corrected. The North Carolina Department of Natural Resources and Community Development (NRCD) sampled the Sandhills streams for macroinvertebrates and prepared an administrative report on their findings relating stream biological communities to water quality.

PLANS FOR NEXT QUARTER:

1. Continue stream and precipitation sampling;
2. Collect storm data at Jordan Creek;
3. Prepare report relating stream chemistry to precipitation chemistry which will serve as final project report for EPA; and
4. Transmit data from project to ADDNET data bank at Oak Ridge National Laboratory.

REPORT STATUS: Records collected as part of this study will be published in the annual data report, "Water-Resources Data for North Carolina." The final progress report for EPA will be prepared for submission to a refereed journal.

PUBLISHED REPORTS: None.

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PROJECT HIGHLIGHTS:

- A. Project stage: Data collection and processing.
- B. Cooperator contacts: Memo on April 17 from the project chief to EPA project officer Charles Powers outlined the conditions for closeout of the EPA funded part of the project. Return memo on April 17 from Powers agreed to all conditions. Memo from project chief to USGS program coordinator Owen Bricker requested additional funding for FY87. No response has been received.
- C. Changes affecting project elements: None.
- D. Problems associated with project: Defective Orion Ross pH electrodes have been sent to manufacturer for replacement and have not been returned. One more series of samples collected during the course of a storm is needed to confirm observations from the November 1985 storm samples.
- E. Hydrologic data released: Water-quality data collected for the project to date were transmitted to NRCO for use in preparing an administrative report on relations between aquatic biological communities and water quality. Data were published in "Water-Resources Data, North Carolina, Water Year 1985."

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INVESTIGATION NC 00-006: Flood Investigations

PERIOD OF INVESTIGATION: 1984 - continuing

INVESTIGATION CHIEF: N. M. Jackson, Jr.

COOPERATOR: Federal Emergency Management Agency

OBJECTIVE: The National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 provide for the operation of a flood insurance program. The Federal Emergency Management Agency (FEMA) needs flood studies in selected areas for administration of the flood insurance program. The objectives of this project are to conduct the necessary hydrologic and hydraulic evaluations and studies of areas assigned by FEMA and to present the results in an appropriate format.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The Ashe County and Louisburg studies were completed, approved by Region, and transmitted to FEMA. Studies for Duplin and Stokes Counties were completed and approved by the Regional Office. Field work was completed for the Scotland County study and office computations are 75 percent complete. Preliminary work on the Jones County study was begun.

PLANS FOR NEXT QUARTER: Study reports for Duplin and Stokes Counties will be finalized and transmitted to FEMA. Jones and Scotland County studies will be finalized and transmitted to FEMA early in the quarter.

REPORT STATUS: Nine reports are scheduled; five have been transmitted to FEMA; two have been approved by Region and will be finalized for transmittal to FEMA, and two are near completion. The reports, "Flood Insurance Study, Town of Mars Hill, North Carolina," "Flood Insurance Study, Town of Southern Pines, North Carolina," "Flood Insurance Study, McDowell County, North Carolina," "Flood Insurance Study, Town of Louisburg, North Carolina," and "Flood Insurance Study, Ashe County, North Carolina," were transmitted to FEMA. Reports for Duplin County, Scotland County, Stokes County, and Jones County are pending.

PUBLISHED REPORTS:

Eddins, W. H., 1978, Flood Insurance Study, City of Charlotte-Mecklenburg County, N. C.: U. S. Geological Survey, HUD Type 15 report.

Jackson, N. M., Jr., 1978, Flood Insurance Study, Town of Blowing Rock, N. C.: U. S. Geological Survey, HUD Type 15 report.

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PUBLISHED REPORTS, continued:

- U. S. Geological Survey, 1978, Flood Insurance Study, Town of Boone, N. C.: U. S. Geological Survey, HUD Type 15 report.
- U. S. Geological Survey, 1978, Flood Insurance Study, Watauga County, N. C.: U. S. Geological Survey, HUD Type 15 report.

REPORTS TRANSMITTED TO FEMA:

- U.S. Geological Survey, 1985, Flood Insurance Study, Town of Mars Hill, N.C.: U.S. Geological Survey, FEMA limited-detail study report.
- U.S. Geological Survey, 1986, Flood Insurance Study, Unincorporated Areas of McDowell County, N.C.: U.S. Geological Survey, FEMA limited-detail study report.
- U.S. Geological Survey, 1986, Flood Insurance Study, City of Southern Pines, N.C.: U.S. Geological Survey, FEMA limited-detail study report.
- U.S. Geological Survey, 1986, Flood Insurance Study, Town of Louisburg, Franklin County, N.C.: U.S. Geological Survey, FEMA limited-detail study report.
- U.S. Geological Survey, 1986, Flood Insurance Study, Unincorporated Areas of Ashe County, N.C.: U.S. Geological Survey, FEMA limited-detail study report.

PROJECT HIGHLIGHTS:

- A. Project stage: Continuing.
- B. Cooperator contacts: Based on field reconnaissance of flooding sources in Columbus and Bladen Counties, FEMA will convert these counties to the regular program without formal studies. We have been asked for time and cost estimates to study flooding in King, Stokes County, N.C. by FEMA.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 00-007: Water-Use Data Program in North Carolina

PERIOD OF INVESTIGATION: 1978 - continuing

INVESTIGATION CHIEF: M. W. Treece, Jr.

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD)

OBJECTIVE: The water-use program is part of a nationwide program to provide comprehensive water-use data that will serve as a valuable tool for the development and management of water resources. Major categories of water withdrawals include public water supplies and self-supplied industrial, commercial, electric-power generation, irrigation, and other rural uses, mining, and waste-water treatment plant uses. Estimates of the amount of water returned to the environment are also included in the program. The program also includes provisions for evaluating existing methods of determining water use and developing ways of improving accuracy of water-use information.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Continued to assemble site-specific water-use information from records maintained by NRCD and other State and Federal agencies. Conducted field investigations to collect water-use information for Camp Lejeune and Onslow County.

PLANS FOR NEXT QUARTER: Continue to: (1) assemble site-specific water-use data and enter the information into the State Water Use Data System (SWUDS); (2) assist NRCD in conducting a telephone survey to update self-supplied industrial water-use data for the major users in the State; (3) enter these newly collected data into SWUDS; (4) finalize estimates of water use for categories in which data are not available and field collection is unfeasible; (5) generate data summaries using SWUDS retrieval software of water withdrawals by county and 4-digit hydrologic subregion, and (6) transfer these summaries to the Regional office in Atlanta using newly developed software designed specifically for this task. These summaries will be used for the 1985 report, "Estimated Use of Water in the United States in 1985."

REPORT STATUS: None in progress at present time.

PUBLISHED REPORTS:

North Carolina Department of Natural Resources and Community Development, 1983, Self Supplied Industrial Water-Use Summary For 1981: Use of Water in North Carolina, 42 p.

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PROJECT HIGHLIGHTS:

- A. Project stage: Ongoing.
- B. Cooperator contacts: Worked with NRCD extensively coordinating data-processing procedures. Met with Allan Dietemann and Dexter Langley to discuss plans for the water-use program for FY 1987.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 76-053: Effects of Channelization on the Hydrology of Chicod Creek Watershed, North Carolina

PERIOD OF INVESTIGATION: 1976-87

INVESTIGATION CHIEF: Robert R. Mason

COOPERATOR: U. S. Department of Agriculture, Soil Conservation Service (SCS)

OBJECTIVE: To determine the effects of channel excavation on the hydrology of the Chicod Creek watershed, including streamflow, surface-water quality, and shallow ground-water conditions.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The collection of data to document post-construction conditions continued. Monthly and quarterly stream-quality samples were collected as scheduled.

PLANS FOR NEXT QUARTER: Continue collection and processing of post-construction data. Present summary of post-construction data collected to date to cooperator at a meeting in August or September.

REPORT STATUS: Collection of data for final report is continuing.

PUBLISHED REPORTS:

Simmons, C. E., and Aldridge, M. S., 1980, Hydrology of the Chicod Creek Basin, North Carolina, Prior to Channel Improvement: U. S. Geological Survey Open-File Report 80-680, 27 p.

Watkins, S. A., and Simmons, C. E., 1984, Hydrologic conditions in the Chicod Creek basin, North Carolina, before and during channel modifications, 1975-81: U. S. Geological Survey Water Resources Investigations Report 84-4025, 36 p.

PROJECT HIGHLIGHTS:

- A. Project Stage: Prior-to- and during-construction phases are complete; second interim report describing findings has been published. Project in final phase of data collection; approximately 9 months of post-construction monitoring remains.
- B. Cooperator contacts: None.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION SR 77-056: Appalachian Basin Waste-Storage Project

PERIOD OF INVESTIGATION: 1977-83

INVESTIGATION CHIEF: O. B. Lloyd, Jr.

COOPERATOR: Federal Research Program - USGS

OBJECTIVE: To determine the presence, thickness, lateral extent and composition of rocks that have potential as reservoirs and reservoir seals for the emplacement and storage of liquid waste in the deep subsurface in segments of the Appalachian basin. The area includes eastern Kentucky, western Maryland, eastern Ohio, southwestern Pennsylvania, east-central Tennessee, southwestern Virginia, and central and western West Virginia (about 60,000 sq. mi.).

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Report has been sent from the southeast Region to Reston with request for Director's approval for publication.

PLANS FOR NEXT QUARTER: Obtain Director's approval for publication.

REPORT STATUS: Lloyd, O. B., Jr., and Reid, M. S., 1985, Evaluation of liquid waste-storage potential based on porosity distribution in the Paleozoic rocks in central and southern parts of the Appalachian Basin: (in review).

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: Final report in review.
- B. Cooperator contacts: None; this study is part of the Federal program.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 78-063: Sediment Characteristics of Streams
in North Carolina

PERIOD OF INVESTIGATION: 1978-84

INVESTIGATION CHIEF: C. E. Simmons

COOPERATOR: North Carolina Department of Natural Resources
and Community Development (NRCD)

OBJECTIVE: The objective of this investigation is to determine the sediment characteristics, such as sediment yield and effects of land use, of streams in North Carolina.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Technical review of report was conducted by private reports specialist during the quarter. Report is ready for colleague review.

PLANS FOR NEXT QUARTER: Forward report to outside colleague reviewers and continue with review process.

REPORT STATUS:

Simmons, C. E., Sediment Characteristics of Streams in
North Carolina, 1970-79: U. S. Geological Survey
Water-Supply Paper (in review).

PUBLISHED REPORTS:

Simmons, C. E., 1976, Sediment Characteristics of Streams
in the Eastern Piedmont and Western Coastal Plain
Regions of North Carolina: U. S. Geological Survey
Water-Supply Paper 1798-0, 32 p.

Data collected during 1984 are published in the report, "Water-Resources Data for North Carolina, Water Year 1984." Similar reports are available for previous years.

PROJECT HIGHLIGHTS:

- A. Project stage: Report ready for colleague review.
- B. Cooperator contacts: None.
- C. Changes affecting project elements: None.
- D. Problems associated with project: Project is complete except for final report.
- E. Hydrologic data released: None.

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INVESTIGATION NC 79-067: Ground-Water Development Potential in the Piedmont and Mountain Areas of North Carolina

PERIOD OF INVESTIGATION: 1979-84

INVESTIGATION CHIEF: C. C. Daniel, III

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD) and Town of Cary

OBJECTIVE: The objectives of this investigation are as follows:

- A. Investigate and describe the most favorable hydrogeologic settings for developing large ground-water supplies;
- B. Develop and describe techniques for locating favorable areas for large ground-water supplies, including locating fractures; and,
- C. Develop techniques for efficient development and management of large ground-water supplies in favorable areas, both as sole sources, and as supplements to reservoir supplies.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: At the recommendation of reviewers, the final report is being divided into several shorter reports covering individual topics, which include: (1) statistical analysis of well data, (2) well pumping rates and scheduling techniques used to increase supply-system production, (3) well-site selection techniques, and (4) hydrogeologic units. The first two of these reports have been written and are in review.

PLANS FOR NEXT QUARTER: Complete District and colleague reviews of the first two reports, revise them in accordance with review comments, and submit for approval for publication.

REPORT STATUS:

Daniel, III, C. C., 1986, Statistical analysis relating well yield to construction practices and siting of wells in the Piedmont and Blue Ridge provinces of North Carolina: U. S. Geological Survey Water-Resources Investigations Report (approved for publication).

Daniel, III, C. C., 1986, Evaluation of site-selection criteria, well design, monitoring techniques, and costs for a ground-water supply in Piedmont crystalline rocks, Cary, North Carolina: U. S. Geological Survey Water-Resources Investigations Report (in review).

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Daniel, III, C. C., and Sharpless, N. B., 1986, Ground-water supply potential and procedures for well-site selection in the upper Cape Fear River basin, North Carolina--Revised 1986: U. S. Geological Survey Water-Resources Investigations Report (previously approved report published by cooperator; revision in progress).

Daniel, III, C. C., 1986, Hydrogeologic unit map of the Piedmont and Blue Ridge physiographic provinces of North Carolina: U. S. Geological Survey Open-File Report (in preparation).

PUBLISHED REPORTS:

Heath, R. C. and Giese, G. L., 1979, What About Groundwater in the Piedmont and Mountains of North Carolina--Are Large Supplies Feasible?: U. S. Geological Survey Leaflet series, 12 p.

Daniel, III, Charles C. and Sharpless, N. Bonar, 1983, Ground-water supply potential and procedures for well-site selection in the upper Cape Fear River basin, North Carolina: North Carolina Department of Natural Resources and Community Development, 73 p.

Daniel, III, C. C., 1985, Statistical analysis of water-well records from the Piedmont and Blue Ridge of North Carolina: Implications for well-site selection and well design (abs.): Geological Society of America Abstracts with programs, v. 17, no. 2, p. 86-87.

PROJECT HIGHLIGHTS:

- A. Project stage: The project is complete except for final reports.
- B. Cooperator contacts: None.
- C. Changes affecting project elements: Final report is being divided into several reports covering individual topics.
- D. Problems associated with project: Project is complete except for final reports.
- E. Hydrologic data released: None.

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INVESTIGATION NC 80-068: Charlotte-Mecklenburg County Urban Hydrology (Water Quality) Study

PERIOD OF INVESTIGATION: 1980-86

INVESTIGATION CHIEF: W. H. Eddins

COOPERATOR: City of Charlotte and Mecklenburg County

OBJECTIVE: The objective of this investigation is to evaluate the effects of urbanization and other developments on water quality. A reconnaissance study of the Charlotte-Mecklenburg County area to determine the quality of surface water, as it relates to land use, has been completed. These data will assist in locating areas where specialized studies will be needed, including chemical-quality characteristics and movement of water pollutants at solid waste-disposal sites and in inner-city and suburban areas.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Ground-water and surface-water chemical analysis records were reviewed. Compilation of data for the water-quality data report continued. Samples were collected at the following landfill sites:

	<u>Observation wells</u>	<u>Privately owned wells</u>	<u>Surface Water sites</u>
Holbrooks Road	2	3	2
Statesville Ave.	3	1	3
York Road	4	0	3
Harrisburg Road	<u>9</u>	<u>1</u>	<u>3</u>
Total	18	5	11

Inorganic and biological constituents were analyzed by Mecklenburg County Environmental Health Department. Organic constituents were analyzed by USGS laboratory in Denver, Colorado.

Samples from the following sites were analyzed for priority pollutants, herbicides, and pesticides:

- | | |
|--------------------------------|----------------------|
| 1. Holbrooks Road Landfill | HRW # 3, 2 |
| 2. Statesville Avenue Landfill | SRW # 22 |
| 3. Harrisburg Road Landfill | HRW # 10, HRW # 2006 |
| 4. York Road Landfill | YRSW # 9 |

A project proposal has been written for new work planned for the Charlotte-Mecklenburg County Urban Water-Quality Study for FY87, FY88, and FY89 and has been submitted to the S.E. Regional office for review.

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Continued evaluation of chemical water-quality data collected from all USGS sites in Mecklenburg County through June 1985. Continued work on interpretive report on chemical water-quality analyses.

PLANS FOR NEXT QUARTER: Continue network operations and sampling at study sites to monitor concentrations of selected organic and inorganic constituents. Continue collection of water samples at landfill and stream sites and give high priority to preparation of the water-quality data report.

Prepare for placement of a nest of monitor wells to be completed at various depths in saprolite at York Road landfill. Ground-water water-quality samples will be collected from these well sites.

Complete interpretation of inorganic and organic water-quality data collected in and around landfill sites in Mecklenburg County. Complete final analyses of borehole geophysical logs.

Begin mineralogical and geochemical evaluation of the saprolite samples collected at York Road and Harrisburg Road landfills in November 1985. Work on preparation of chemical water-quality interpretive report.

REPORT STATUS: The reconnaissance report on water quality of streams was published and distributed in June 1985. The following report is being prepared:

Eddins, W. H. and Cardinell, A. P., 1986, Chemical-quality data for the urban hydrology study of Mecklenburg County, North Carolina, 1980-85: U.S. Geological Survey Water-Resources Investigations Report (in process).

PUBLISHED REPORTS:

Eddins, W. H., and Crawford, J. K., 1984, Reconnaissance of water-quality characteristics of streams in the City of Charlotte, Mecklenburg County, North Carolina: U. S. Geological Survey Water-Resources Investigations Report 84-4308, 105 p., 45 figs., 26 tables.

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PROJECT HIGHLIGHTS:

- A. Project stage: Study is 92 percent complete.
- B. Cooperator contacts: Daily contact.
- C. Changes affecting project elements: Alex Cardinell has assumed responsibility for part of the study concentrating on data analysis and interpretation.
- D. Problems associated with project: None.
- E. Hydrologic data released: Data are supplied on request to cooperating agencies and others.

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INVESTIGATION NC 80-070: Urban Hydrology of the Coastal Plain

PERIOD OF INVESTIGATION: 1980 - continuing

INVESTIGATION CHIEF: H. C. Gunter

COOPERATOR: North Carolina Department of Transportation (DOT)

OBJECTIVE: The objectives of this investigation are to evaluate the effects of urban development on flood magnitude and frequency in the Coastal Plain province and update regional flood relations for North Carolina

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: First draft of report was completed, and report is currently in in-house review.

PLANS FOR NEXT QUARTER: Complete in-house review of report and begin colleague review.

REPORT STATUS: Preparation of the final report is continuing.

Gunter, H. C., 1986, Regional flood-frequency relations for urban and rural basins in North Carolina: U. S. Geological Survey Water-Resources Investigations Report (in preparation).

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: First draft of report complete.
- B. Cooperator contacts: None.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 80-071: Coastal Plain Aquifer Study

PERIOD OF INVESTIGATION: 1980-86

INVESTIGATION CHIEF: G. L. Giese

COOPERATOR: Federal

OBJECTIVE: The objective of this investigation is to develop the capability to make predictive evaluations of the Coastal Plain aquifer systems under existing and future conditions. A digital model to simulate the response of the multi-layered aquifer system under varying pumping and climatic stresses will require detailed information on the following:

- A. Geology and hydrology of the aquifer system;
- B. The ground-water flow system and freshwater-saltwater interface before extensive ground-water withdrawals began.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: A revised draft of the model report was prepared following supervisory review and organizational review by the Regional Reports Specialist. The model report was submitted to the District Reports Specialist for appraisal prior to colleague review. The hydrogeologic framework report was revised following colleague review and was sent to Henry Trapp prior to submission for approval as an Open-File Report pending publication as a U.S. Geological Survey Professional Paper.

PLANS FOR NEXT QUARTER: Submit model report for colleague review. Submit hydrogeologic framework report for approval for publication as indicated above.

REPORT STATUS: As indicated above, both planned reports will be prepared for publication as Open-File Reports and later as U.S. Geological Survey Professional Papers.

Winner, M. D., Jr., and Coble, R. W., 1987, A hydrogeologic framework of the North Carolina Coastal Plain aquifer system: U. S. Geological Survey Professional Paper (in review).

Giese, G. L., Eimers, J. L., and Coble, R. W., 1987, Conceptualization, mathematical representation, and hydrologic analyses of the North Carolina Coastal Plain aquifer system: U. S. Geological Survey Professional Paper (in preparation).

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PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: Both framework and modeling phases of the study are complete except for report processing.
- B. Cooperator contacts: None.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 83-073: Water Quality of Inflow to Falls and Jordan Lakes, North Carolina

PERIOD OF INVESTIGATION: October 1982-87

INVESTIGATION CHIEF: R. G. Garrett

COOPERATOR: U. S. Army Corps of Engineers

OBJECTIVE: The 12,500-acre Falls Lake was filled in June 1983, and the 13,900-acre Jordan Lake was filled in February 1982. Few data are available on the quality of inflow to the lakes; however, several cities plan to use the lakes for public water supply. The objective of this project is to collect hydrologic data for evaluating chemical-quality characteristics of inflow under existing and future development conditions.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The collection and processing of water-quality data at the Falls project stations continued. As reported previously, the collection of data for the Jordan Lake stations was completed in November 1985.

PLANS FOR NEXT QUARTER: Continue collection, processing, and storage of data in the WATSTORE system for the Falls project sites.

REPORT STATUS: No interpretive reports in progress at this time; however, all basic data collected as part of this project will be published in annual reports, "Water-Resources Data for North Carolina."

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: Data-collection phase.
- B. Cooperator contacts: Data, program funding, and objectives for FY 86 were discussed with Corps personnel.
- C. Changes affecting project elements: The water-quality data collection for the sites located at Jordan Lake were discontinued in November 1985. A large tributary stream was added to the inflow data network of the Falls Lake requiring an extension of the project to June 1987. Additional data will be collected to meet project objectives.
- D. Problems associated with project: None.
- E. Hydrologic data released: Provisional water-quality data available as of April 15 were released to the cooperator. Preliminary computations of inorganic nitrogen and ortho-phosphorus influx into the Falls and Jordan Lakes during the 1985 WY were transmitted to the cooperator.

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INVESTIGATION NC 83-074: Effects of Stream Restoration on the Hydrology of the Grove Creek Watershed near Kenansville, North Carolina

PERIOD OF INVESTIGATION: October 1982-87

INVESTIGATION CHIEF: T. C. Stamey

COOPERATOR: North Carolina Department of Human Resources (DHR)

OBJECTIVE: The objective of this investigation is to define the hydrology of Grove Creek watershed before, during, and after channel restoration and to evaluate the impact of channel restoration on frequency and duration of overbank floodings, ground water, and water quality. The project was expanded to define ground-water and surface-water characteristics on open-marsh water-management projects at Hobucken and West Onslow Beach.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Data collection continued at network stations in the Grove Creek watershed and at Hobucken and West Onslow Beach Marshes.

PLANS FOR NEXT QUARTER: Continue collection, processing, and storage of streamflow, ground-water, and water-quality data in the WATSTORE files. Correlate water levels in the breeding pools with those for the observation wells (as the data are received from cooperator).

REPORT STATUS: None in progress.

PUBLISHED REPORTS:

Stamey, T. C., 1986, Frequency and duration of flooding of Grove Creek near Kenansville, North Carolina, for present and proposed restored channel conditions: U. S. Geological Survey Water-Resources Investigations Report 85-4298.

PROJECT HIGHLIGHTS:

- A. Project stage: Data collection and analysis.
- B. Cooperator contacts: Numerous contacts were made with DHR to discuss plans and progress at project sites.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 83-075: Central Coastal Plain Aquifer Study

PERIOD OF INVESTIGATION: 1983-88

INVESTIGATION CHIEF: M. D. Winner, Jr.

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD); the cities and towns of Ayden, Farmville, Jacksonville, Kinston, La Grange, New Bern, Pinetops, Snow Hill, and Stantonsburg; Greene, Jones, and Onslow Counties; Greenville Utilities; and North Lenoir Water Corporation.

OBJECTIVE: The objectives of the study are to evaluate: (1) ground-water supply potential of the Central Coastal Plain; and, (2) effects of alternative ground-water development schemes, especially with regard to maximum-development potential, declines in regional water levels, and saltwater intrusion. To accomplish these objectives, the study will include construction of a detailed hydrogeologic framework for the 3,600 mi² area and development of steady-state and transient digital models to analyze the ground-water flow system.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Two observation wells have been completed by NRCD; one is 831 ft deep and open to the lower Cape Fear aquifer at Chicod, Pitt County, and the other is 845 ft deep and open to the Black Creek aquifer at the Jacksonville well field in Onslow County.

Records from observation wells at the centers of well fields are showing that water levels in aquifers both above and below the production aquifers are responding to the effects of pumping. Vertical leakage through confining units may be a significant source of aquifer recharge in the immediate vicinity of a heavily pumped well field.

Framework correlations were completed for about 40 wells in the Onslow-Jones area, and altitude maps for the basement surface and six aquifers and six confining units were finished.

Work continued on updating the new model format, and a new model grid was designed.

PLANS FOR NEXT QUARTER: Draft of the framework report for the original study area should be completed and ready for the review process. Work will begin on entering framework data into the new model format to start a series of model-calibration tests.

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REPORT STATUS: The following report has been approved for publication and will be distributed as soon as available:

Lyke, William L., and Winner, M. D., Jr., 1986, Altitude of basement surface in the central Coastal Plain of North Carolina: U. S. Geological Survey Water-Resources Investigations Report 86-4082.

The following report has been completed and is in review:

Winner, M. D., Jr., and Lyke, William L., 198-, History of ground-water pumpage from Cretaceous aquifers of the central Coastal Plain of North Carolina, and the decline of water levels: U. S. Geological Survey Open-File Report.

The following report is in preparation:

Winner, M. D., Jr., and Lyke, William L., 198-, The hydrogeologic framework of the central Coastal Plain, North Carolina: U. S. Geological Survey Water-Resources Investigations Report.

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: Data-collection and evaluation stage of the study overlaps with the report preparation stage. A number of reports will be prepared at various stages of the investigation.
- B. Cooperator contacts: Several contacts were made with NRCD on test drilling and other aspects of the study. Winner and Lyke presented a project progress report at an intergovernmental meeting of community and county officials of Onslow County.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 84-076: Effects of Land Use on the Biological Environment of Streams in Piedmont North Carolina

PERIOD OF INVESTIGATION: 1984-86

INVESTIGATION CHIEF: J. Kent Crawford

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD)

OBJECTIVE: This investigation examines the effects of three land uses (forests, agriculture, and urban) on stream environments. The objectives are to:

1. Monitor the chemical characteristics of the water column including transport in solution and transport associated with suspended sediment;
2. Monitor the chemical and physical characteristics of bed material including both sediments and interstitial water;
3. Characterize the aquatic invertebrate communities of each of the study streams; and,
4. Relate biotic degradation found during the study to water quality, sediment quality, and land-use activities.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Draft of the final report is nearing completion.

PLANS FOR NEXT QUARTER: Complete report and terminate project.

REPORT STATUS: One interpretive report and a journal article are planned. Draft of interpretive report is due July 1, 1986. Final approved version is due September 30, 1986.

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: Data collection complete. Data analysis and report preparation underway.
- B. Cooperator contacts: Telephone contact was maintained during the quarter with Dave Lenat, NRCD.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: Data were released in "Water Resources Data, North Carolina, Water Year 1985."

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INVESTIGATION NC 84-077: The Effects of Land Use on Ground-Water Quality in the Piedmont Province, North Carolina.

PERIOD OF INVESTIGATION: 1984-86

INVESTIGATION CHIEF: Douglas A. Harned

COOPERATOR: Federal

OBJECTIVE: The objective of this investigation is to study the quality of ground water of the combined-regolith and fractured-rock ground-water system and to assess the current status of contamination in the system under typical land uses. This will be a two-phase study. The first, and current phase, is the analysis of existing data. The second phase will be monitoring and hypothesis testing based on findings of the first study phase.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Colleague reviews of the Phase I report were obtained from J. L. Eimers, USGS, Raleigh, North Carolina, and Jacob Gibs, USGS, Trenton, New Jersey. A paper presenting the design aspects of the study was presented at the Sixth National Symposium and Exposition on Aquifer Restoration and Ground-Water Monitoring, May 20, in Columbus, Ohio.

PLANS FOR NEXT QUARTER: None. If new funding is obtained, however, plans involve merging the edited data file; areal characteristics, including LUDA land use, geology, and soils data will continue to be added to the file. Preparation of the data report will begin.

REPORT STATUS: Completion of the following data report is planned if new funding is obtained.

Harned, D. A., 1986, Ground-water quality data for the Piedmont of North Carolina: U. S. Geological Survey Water-Resources Investigations Report (in process).

Review and revision of the following interpretive report continues:

Harned, D. A., 1986, The effect of land use on ground-water quality in the Piedmont province, North Carolina: U. S. Geological Survey Water-Supply Paper.

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PUBLISHED REPORTS:

Harned, D. A., 1986, Design of a monitoring network to detect the effects of land use on ground-water quality and describe the contaminant system in the Piedmont of North Carolina: paper for presentation at the Sixth National Symposium and Exposition on Aquifer Restoration and Ground-Water Monitoring, National Water Well Association (in colleague review).

PROJECT HIGHLIGHTS:

- A. Project stage: Phase I nearly complete.
- B. Cooperator contacts: Federal program - no local cooperators.
- C. Changes affecting project elements: Funding for this study has been canceled. The second phase will not be initiated. Preparation of reports covering the first phase will resume if new funding is allocated.
- D. Problems associated with the project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 85-081: Effects of Land-Management Practices
on Sediment and Chemical Transport
in Guilford County

PERIOD OF INVESTIGATION: 1984-91

INVESTIGATION CHIEF: C. L. Hill

COOPERATOR: Guilford County Soil and Water Conservation
District and U. S. Soil Conservation Service
(SCS)

OBJECTIVE: Runoff from agricultural lands is a major contributor of sediment, nutrients, and toxics to surface and ground waters in North Carolina. The full impact of agricultural runoff is unknown and large-scale improvements cannot be accomplished until further knowledge is gained regarding pollutant sources and levels, transport and assimilative mechanisms, degradation and alteration of pollutants, and methods of improvements. Primary objectives are as follows:

- A. Quantify fluvial sediments and associated chemical constituents transported from a basin using good land management techniques and compare with similar variables from a basin where accepted soil-conservation practices are not currently used;
- B. Define changes in quantities of sediment and selected nutrients and pesticides following implementation of soil conservation practices in a rural, mixed, land-use basin.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER:

1. First runoff event of this water year occurred and water-quality samples were collected at 3 of the 4 sites;
2. Erosion pins installed above both runoff gages in the tobacco fields;
3. Levels run at both tobacco fields to check reference gages at runoff sites;
4. Detection limits of the 7 organic constituents being studied were lowered by Research Triangle Institute (RTI) from 10 ppb to .05-2 ppb; and
5. Abstract for inclusion in proceedings of the Weed Science Society of North Carolina conference was approved by Region for publication.

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PLANS FOR NEXT QUARTER:

1. Continue intensive water-quality sampling of all sites if weather permits;
2. Determine feasibility of RTI developing the methodology to determine concentrations of the 7 organic constituents in soil; and
3. Begin taking samples for soil moisture as suggested by S.E. Region and branch review teams.

REPORT STATUS: No interpretive reports currently in progress; data will be published in the annual data report, "Water-Resources Data for North Carolina," beginning with the 1985 report.

PROJECT HIGHLIGHTS:

- A. Project stage: Data collection.
- B. Cooperator contacts: Numerous contacts with SCS personnel in Raleigh, Guilford County, and Fort Worth, Texas.
- C. Changes affecting project elements: None.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 86-083: Ground-Water Supply and Potential for Contamination, Cherry Point Marine Corps Air Station, North Carolina

PERIOD OF INVESTIGATION: April 1986 to March 1990

INVESTIGATION CHIEF: C. C. Daniel, III

COOPERATOR: Federal (U.S. Navy - Marine Corps)

OBJECTIVE: The objectives of this study are as follows:

- A. Evaluate the quality of ground-water being pumped from the Air Station wells that tap the artesian-limestone aquifer (water-supply aquifer);
- B. Evaluate the potential for contamination of the water-supply aquifer by hazardous and toxic wastes that occur at various surface disposal sites at the Air Station and by saline-water encroachment; and
- C. Investigate alternative ground-water use and management practices that will help reduce the chances for contamination of the water-supply aquifer.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Several trips to the Air Station were made by project staff during the quarter to collect data on wells, visit sites that are potential sources of ground-water contamination, begin identifying sites for the drilling of test wells, and to make arrangements for the collection of ground-water samples.

Well records in the Air Station engineering department were reviewed and those containing information on well construction, well yield, aquifer tests, geologic and geophysical logs, water quality, and other useful hydrogeologic information were copied for inclusion in the District ground-water files. Information on approximately 75 wells has been compiled.

Specialized sampling equipment and sampling supplies were ordered and most have been delivered. Personal safety equipment has also been obtained.

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PLANS FOR NEXT QUARTER:

- A. Collect water samples from supply wells and ship to labs for analysis;
- B. Run geophysical logs on the supply wells at the same time that samples are being collected;
- C. Continue analysis of well records and begin development of a hydrogeologic framework for the aquifer system beneath the Air Station; and
- D. Develop outline for report on first phase of the study.

REPORT STATUS: New project; none in progress.

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: The project is 6 percent completed.
- B. Cooperator contacts: Periodic contacts with staff members from Natural Resources and Environmental Affairs, Facilities Engineering and Facilities Maintenance in order to make plans for sampling and assistance with pump removal during sampling.
- C. Changes affecting project elements: None.
- D. Problems associated with project: Prolonged drought has resulted in all supply wells being pumped continuously except in event of pump failure. Reserve capacity minimal or non-existent. Facilities Maintenance will not take wells out of service for sampling under these conditions. Without a break in the drought, sampling may be delayed.
- E. Hydrologic data released: None.

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INVESTIGATION NC 86-084: An Appraisal of the Ground-Water Resources of Camp Lejeune Marine Corps Base, North Carolina

PERIOD OF INVESTIGATION: 1986-89

INVESTIGATION CHIEF: Douglas A. Harned

COOPERATOR: Federal

OBJECTIVE: The objectives of this study are to describe the ground-water resources of the Base and environs and to construct an appropriate ground-water flow model that will be used to evaluate alternative ground-water use and management practices. This is a three-phased study: the first phase is examination of available data; the second phase is collection of additional data and construction of new observation wells, and the third phase is modeling.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: An initial organizational meeting of the principal participants in the study was held April 29 to review the first year of the work plan. A well inventory was begun; some water-use data were obtained, and two water-level monitors were installed.

PLANS FOR NEXT QUARTER: Continue examination of existing water-use and well data.

REPORT STATUS: Data collection and analysis for the annual project report is underway.

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: Phase I - review of existing data and preliminary description of the geohydrologic framework.
- B. Cooperator contacts: Organizational meeting participants included Bob Alexander of AC/S Facilities, Carl Baker with Public Works, Elizabeth Betz and Julian Wooten with the Natural Resources Division, Junior Johnson with Utilities, Fred Cone with Public Works, and Rick Shiver with the North Carolina Department of Natural Resources and Community Development.
- C. Changes affecting project elements: Water use will be stressed in the first year report.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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INVESTIGATION NC 86-085: A Reconnaissance Evaluation of Surface Water, Drinking Water, and Effluent Water Quality in the Greensboro, North Carolina Area

PERIOD OF INVESTIGATION: 1986-1988

INVESTIGATION CHIEF: Marjorie S. Davenport

COOPERATOR: City of Greensboro, North Carolina

OBJECTIVE: To define the quality of water of streams in the Greensboro area with particular emphasis on trace elements, nutrients, and synthetic organic chemicals; to define the quality of water at the intake of Greensboro's raw drinking water supplies and at the outflow from Greensboro's two wastewater treatment plants; to compare the quality of waters draining urban, suburban, and rural watersheds; to determine annual loadings of nutrients, trace elements, and synthetic organic compounds at one site in the Greensboro area; and to identify relative amounts of stream pollutants coming from various sources.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Installation of hydrologic instruments was completed. Nine wire-weight gages, one staff gage, two ADR continuous record stations, and one manometer-type continuous record station were installed. One of the 13 water-quality stream-sampling sites has an established stable rating curve. Two flow measurements have been taken at each of the remaining stream sites for future development of the 12 rating curves. A training session for collection and preservation of water-quality samples was conducted by Gary Garrett, USGS, April 1 with City of Greensboro laboratory personnel. Water-quality samples were collected April 15 and 16 for analyses of major ions, nutrients, trace elements, TOC, and general water quality indicators at 19 sampling sites including one duplicate and one field blank. Sampling sites included 13 stream sites, two raw and finished drinking-water sites, and two wastewater-treatment plant effluent sites. Station locations and results were logged into QWDATA on the Prime. Data analysis has consisted of comparison of water quality between locations. A second routine sampling was done for the week of June 16. Samples were collected for both inorganic and organic analyses including major ions, nutrients, trace elements, general water-quality indications, TOC, acid-base-neutral extractable organics, volatile organics, and organochlorine/organophosphorus compounds in water. Bed material samples were taken at three sampling sites for analysis of acid-base-neutral extractable and organochlorine compounds.

PLANS FOR NEXT QUARTER: Continued analyses of data from all samplings to date. At least one bimonthly sampling will be done in early August. Weather permitting, an event sampling will be conducted. Flow measurement at 12 stream sites will continue.

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REPORT STATUS: None.

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

- A. Project stage: Construction phase is complete. Data collection and analysis stage in progress.
- B. Cooperator contacts: Training session April 1 with lab personnel. Letter to Ray Shaw, Assistant Director of Public Works, City of Greensboro, informing him of proposal refinements and sampling plans.
- C. Changes affecting project elements: Only volatile organic samples will be sent to the USGS central lab in Denver. Samples to be analyzed for acid-base-neutral extractable and organochlorine/organophosphorus compounds will be sent to the TVA lab in Chattanooga, Tennessee. The Greensboro Osbourne Wastewater Treatment Plant laboratory does not have the capability to do an EPA approved procedure for cyanide. The limitations of the electrode procedure being used will be documented in the final reports.
- D. Problems associated with project: None.
- E. Hydrologic data released: None.

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OTHER PROGRAM ACTIVITIES

1. On April 14 and 15, 1986, Dennis Lettenmaier, University of Washington, and Art Ott, USGS, Pennsylvania District, reviewed NASQAN program activities in North Carolina. The review team gathered information on length and quality of records, uses of water-quality data, operational problems, importance of monitoring sites, and various other aspects. The NASQAN program is undergoing redesign and consolidation. The data obtained will be used in identifying stations to be dropped from the network.

2. A proposed new study of four landfills in Charlotte/Mecklenburg County will include surface geophysical surveys, well testing, and the collection of saprolite samples and stream-sediment samples. The data base will be used to help define the hydrogeologic setting at landfills, delineate existing leachate plumes, establish a geochemical data base, and obtain a better understanding of ground water. Surface water and water quality are to be monitored at selected sites in metropolitan Charlotte and an industrial area in Mecklenburg County.

3. A \$300,000 grant has been made under the Environmental Protection Agency's (EPA) National Estuary Program for research in Albemarle and Pamlico Sounds. "The idea is to have a five-year effort with funding following a bell-shaped curve," said Howard L. Marshall, manager for the Albemarle-Pamlico project in the EPA's regional office in Atlanta. "Funding in middle years should exceed \$1,000,000 per year." (The News and Observer, Raleigh, North Carolina, April 16, 1986.)

According to an aide of U.S. Representative Walter B. Jones (First Congressional District, North Carolina), the \$300,000 is an outright grant to North Carolina to cover start-up studies. In subsequent years, funding will be on a matching basis with the State.

The study was prompted by concerns for declining water-quality conditions in the Sounds area and increasing environmental and biological problems. Further research is needed to better understand how salinity, tides, freshwater inflow, and biological factors interact in response to man-caused stresses in order to provide the information needed to preserve and manage the estuarine resources system.

4. Doug Harned, Bruce Lloyd, and Steve Howe, USGS, met April 29, 1986, with staff of the Camp Lejeune Marine Corps Base to present the project's work plan. Camp Lejeune staff included Bob Alexander of Facilities, Carl Baker of Public Works, Elizabeth Betz and Julian Wooten of the Base Natural Resources Department, and Junior Johnson and Fred Cone of Base Maintenance.

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OTHER PROGRAM ACTIVITIES, Cont'd.

Rick Shiver of the North Carolina Department of Natural Resources and Community Development was also present. The meeting was followed by initial site reconnaissance of potential monitoring sites. The four-year investigation will involve primarily an assessment of available data for the first year.

5. On May 2, 1986, Ed Simmons and Dale George, USGS, met with officials of the Haywood County Soil and Water Conservation District and the Soil Conservation Service (USDA) to discuss sediment problems and possible cooperative studies in the Richland Creek basin of Haywood County. Rapid development of this mountainous basin during the past several years has severely increased erosion. Stream channels have aggraded, and a premier resort lake, Lake Junaluska, has almost filled with sediment. The objectives of a cooperative study would include: (1) determination of the effects of various types of land use on sediment transport, and (2) determination of changes in transport following implementation of erosion-control ordinances.

MEETINGS AND COORDINATION ACTIVITIES

1. The North Carolina Water Resources Association held its spring conference and luncheon on May 9, 1986, at the North Carolina State University Faculty Club. The theme of the conference was "Protecting North Carolina's Surface Drinking Water Sources." The program featured seventeen speakers from government organizations, private firms, and universities, with Joseph A. Coturvo, Director of EPA's Criteria and Standards Division, as the luncheon speaker. Turner, Meeks, Crawford, Harned, Eimers, and Treece attended from the USGS.

2. The North Carolina District was advised by Bob Reynolds, Information Transfer Program, Reston, that Secretary Hodel, accompanied by North Carolina Congressmen Broyhill and Hendon, planned to visit Asheville on May 15 in regard to State and local opposition to a proposed nuclear waste site in western North Carolina. The District prepared a briefing paper on Congressional and water issues of the State, including proposed nuclear waste repository sites, Lake Gaston pipeline, Albemarle-Pamlico Sound Estuarine Study, acid deposition effects on Mount Mitchell, and drought conditions.

3. On May 23, 1986, Dr. Ellis Cowling, Dr. Robert Bruck, and Dr. V. K. Saxena, North Carolina State University, met with the USGS staff to discuss proposed hydrological investigations in the area of Mount Mitchell, North Carolina.

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MEETINGS AND COORDINATION ACTIVITIES, Cont'd.

Mount Mitchell is the highest peak east of the Rocky Mountains, and the red spruce and frazier fir forests of Mount Mitchell and other high elevation Southern Appalachian peaks are rapidly declining. Acid deposition is suspected as a causative agent in the decline. Current studies on the mountain include cloud chemistry, precipitation chemistry, throughfall and stemflow, forest monitoring, and soil investigations. Studies of the aquatic system are needed to help understand the fate of pollutants deposited from the atmosphere. USGS participation would involve runoff and water-quality monitoring at several high-altitude test sites on Mount Mitchell.

4. On May 23, 1986, Jim Turner and Charles Daniel, USGS, North Carolina, and Byron Prugh, USGS, Virginia, met with representatives of the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service in Norfolk, Virginia, to discuss a proposed interstate water-resources study of the Great Dismal Swamp. Prevailing drought conditions in southeastern Virginia and northeastern North Carolina have impacted the Great Dismal Swamp and the Dismal Swamp Drainage Canal for several years. Environmental stress on water in the Canal to support tourism to the Great Dismal Swamp is sensitive to residents of Elizabeth City. A water-budget model was suggested for the Dismal Swamp and surrounding area. The Survey is to prepare a proposal for development of the model by July 31, 1986.

5. On June 6, 1986, Jim Turner and Jerry Giese, USGS, met with representatives of various State and Federal agencies at Duke Marine Laboratories, Beaufort, North Carolina, to discuss the roles of various Federal, State, and local agencies in proposed estuarine studies of Albemarle-Pamlico Sounds. Other attendees included: Howard Marshall, EPA, Region 4, Atlanta, Georgia; Mark Alderson, EPA, Washington, D.C.; Preston Pate, Coastal Management, NRCO; Harold Johnson, Marine Fisheries; Doug Rader, Division of Environmental Management; John Meeshaw, Corps of Engineers; Mike Gantt, U.S. Fish and Wildlife Services; and Bud Cross, National Oceanic and Atmospheric Administration.

6. On June 5, 1986, Carl Goodwin of the Tampa, Florida, subdistrict visited Raleigh to confer with District personnel on estuarine studies and to give a talk on "Hydrodynamic modeling in Florida estuaries, with emphasis on circulation and flushing." The talk was attended by more than 50 representatives from Federal and State agencies and many university researchers. Goodwin's talk was enthusiastically received and was especially timely because of the proposed Albemarle and Pamlico Sounds Estuarine Study.

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MEETINGS AND COORDINATION ACTIVITIES, Cont'd.

7. The U.S. Department of Energy (DOE) has identified 12 preliminary candidate areas as possible high-level radioactive waste repositories. The 12 sites were selected from 235 crystalline-rock bodies located in 17 states in the north-central, northeastern, and southeastern parts of the United States.

Two sites targeted in North Carolina are the Rolesville pluton site, north of Raleigh, and the Elk River complex site near Asheville. The State objects to the selection of these sites on geologic, hydrologic, population, and land-use grounds.

8. On April 3, 1986, Jim Turner, Ed Simmons, Ron Coble, Macon Jackson, and Wanda Meeks, USGS, met with John Morris, John Wray, Steve Tedder, and other staff members of the North Carolina Department of Natural Resources and Community Development (NRCD) to plan the State/USGS cooperative program for FY87. Possible Federal funding reductions were of concern. NRCD indicated a high interest in improving the accuracy of low-flow estimates and agreed to support a statewide regionalization study; NRCD is also highly interested in initiating a statewide study of reservoir sedimentation.

9. On April 16, 1986, Mike Winner, USGS, was invited to speak at an inter-governmental meeting of officials of the cities and towns of Onslow County with county officials at Jacksonville, North Carolina. The topic was the progress on the cooperative ground-water study in the central Coastal Plain, which includes Jones and Onslow Counties.

10. The Southeast Region Computer Specialist and Site Managers' meeting was hosted by the North Carolina District on April 23-25, 1986; twenty-four representatives from Southeast Region districts and Art Putnam, Doug Posson, Isabelle Halley, and Gail Kalen from Headquarters attended. Topics discussed included: activities in the National Water Information System (NWIS), Administrative Financial Management System (AFiMS), and Information Systems Division (ISD), standardized operations manuals, and the general operations and concerns of each District.

11. The results of Masters thesis work in geology by Bill Lyke, USGS, has been published in volume 26, number 3, of Southeastern Geology. This work was done while he attended the University of North Carolina at Chapel Hill. The title of the paper is "The Stratigraphy, Paleogeography, Depositional Environment, Faunal Communities, and General Petrology of the Minnehaha Springs Member of the Appalachians."

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MEETINGS AND COORDINATION ACTIVITIES, Cont'd.

12. On May 13, 1986, Jim Turner and Ed Simmons, USGS, conferred with officials of the U.S. Fish and Wildlife Service at Manteo, North Carolina, regarding a possible study of a 140,000-acre wildlife preserve in Dare County. A large portion of the area has undergone extensive channelization and timber clearing by agricultural and wood products concerns, causing unknown changes in hydrology. The U.S. Fish and Wildlife Service is proposing a study of current hydrologic conditions with emphasis on a means of gradually restoring the area to its former primitive state. The USGS is to prepare a preliminary proposal for initiating the data-collection networks in FY87.

13. Douglas Harned, USGS, presented the paper, "Design of a monitoring network to detect the effects of land use on ground-water quality and describe the contaminant flow system in the Piedmont of North Carolina," at the National Water Well Association's Sixth National Symposium on Ground-Water Monitoring. The symposium was held May 19-22, 1986, in Columbus, Ohio, and stressed technical aspects of monitoring and aquifer restoration.

14. On May 20-21, 1986, the North Carolina Water Resources Congress met in Washington, D.C. to discuss priorities for water projects with the North Carolina Congressional Delegation and others. The group expressed concerns for budget reduction for construction and water projects in the State. The group supports water resources programs of the U.S. Geological Survey in North Carolina, particularly the Federal-State Cooperative Program.

15. Jim Stewart, University of North Carolina Water Resources Research Institute, and Carl Bailey, North Carolina Department of Natural Resources and Community Development (NRCD), met with Ron Coble, Wanda Meeks, Bruce Lloyd, Charles Daniel, Doug Harned, and Steve Howe, USGS, on May 28, 1986, to request assistance in providing training courses for NRCD and North Carolina Department of Human Resources professionals and technicians on ground-water pollution, risk assessment, practical hydrogeology, and ground-water pollution response, respectively. The courses are to be held in Raleigh during the fall 1986; Ron Coble and Mike Winner will serve as instructors. Charles Daniel will present a session on Piedmont hydrogeology. USGS has also been asked to present results of the Pensacola and Cape Cod projects hazardous waste studies.

16. The Neuse-White Oak Citizens Advisory Committee held their quarterly meeting on May 29, 1986, in Wilson, North Carolina; Wanda Meeks and Marjorie Davenport, USGS, attended. Frank Snipes and Larry Saunders, Corps of Engineers, Wilmington, North Carolina District, spoke about the Buckhorn Reservoir Project near Wilson, North Carolina.

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MEETINGS AND COORDINATION ACTIVITIES, Cont'd.

John Garrett, Soil Conservation Service, discussed the Contentnea Creek Watershed Erosion study. An update on the Upper Neuse River Basin, including discharge rates at Falls Lake, was presented by John Wray, Division of Water Resources, State of North Carolina.

17. On June 4, 1986, Ron Coble, USGS, presented a talk at the annual meeting of the North Carolina Water Resources Congress. The program consisted of presentations by several agencies and groups on accomplishments during the last year and needs for the future. Presentations were also made by the Corps of Engineers (COE), Soil Conservation Service (SCS), North Carolina Ports Authority, Water Resources Research Institute (WRI), and Tennessee Valley Authority (TVA). Thomas Rhodes, Secretary of the North Carolina Department of Natural Resources and Community Development, gave the keynote address at the luncheon, emphasizing progress in water resources development and protection over the last few years. The COE, SCS, and TVA emphasized their desire to satisfy local interest and the need for local financial involvement in future projects. Congress members were enthused about USGS efforts to improve surface-water, ground-water, and water-quality data networks.

18. On June 4, 1986, Marjorie Davenport, USGS, participated in a four-day Water Table Management Seminar sponsored by the North Carolina Agricultural Research Service (ARS) and Soil Conservation Service (SCS). Approximately 130 SCS, NRCD, USDA-ARS, and NCSU staff and faculty attended the seminar. Davenport spoke to the tour group about past and current research conducted at drainage and sub-irrigation research sites. The seminar included a tour of the Mitchell Creek Fabriadam water-control structure and a pumped drainage and sub-irrigation research system.

19. Jim Turner and Jerry Giese, USGS, attended the fourth annual convention of the North Carolina Coastal Federation on June 7, 1986, at the Duke University Marine Laboratory in Beaufort, North Carolina. The focus of the convention was the proposed interagency study of Albemarle and Pamlico Sounds. Several hundred people attended the meeting. The keynote speaker was Jack Raven, Regional Administrator, EPA, Atlanta, Georgia.

20. On June 19, 1986, SCS representatives, including John Burt, water-quality specialist, Pete Waldo, sediment geologist, and Emit Waller and Tyler Smith, reviewed progress of the Guilford County Land-Use Study. Cathy Hill, USGS, participated in the review and conducted a field visit to all sites. The project is progressing as scheduled, although lack of normal amounts of precipitation has resulted in only one flow event occurring this year. John Burt will visit the USGS Raleigh office in late summer or early fall with a copy of the CREAMS model.

